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Report to the Chairman, Subcommittee on Investigations and Oversight, Committee on Public Works and Transportation, House of Representatives

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HIGHWAY SAFETY

Trends in Highway Fatalities 1975-87

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GAO

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Program Evaluation and
Methodology Division

B-237223

March 9, 1990

The Honorable Glenn M. Anderson
Chairman, Subcommittee on Investigations and Oversight
Committee on Public Works and Transportation
House of Representatives

Dear Mr. Chairman:

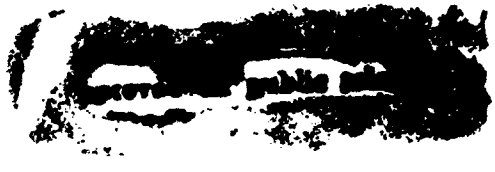
On October 11, 1988, the Subcommittee Chairman requested that we undertake a study of fatal traffic accidents in the United States over a 13-year period for which there are data in the Fatal Accident Reporting System (FARS). The request asked that we focus on motor vehicle safety policies as they relate to the vehicle, the driver, and the roadway environment in 1975 through 1987. The request also asked that we give particular attention to several highway environment issues—namely, (1) narrow bridges, (2) operational deficiencies (for example, the absence of traffic controls), (3) wet weather performance, (4) studded tires, (5) freeway signs and related highway geometry, and (6) roadside hazards.

Most of the information in this letter and its appendixes is derived from data for 1975 through 1987 in the FARS data base, developed and maintained by the National Highway Traffic Safety Administration (NHTSA). FARS includes data on about 41,000 fatal accidents per year involving about 60,000 vehicles and about 110,000 persons who may be vehicle occupants, pedestrians, or cyclists.

Background

The National Safety Council reports that since 1948, there have been about 100,000 accidental deaths per year and, on the average, almost half of these deaths resulted from motor vehicle accidents. Motor vehicle accidents are the leading cause of accidental death overall and the leading cause of accidental death for persons age 1 to 74. For persons 75 and older, motor vehicle accidents are the second leading cause of death from accidents, exceeded only by deaths resulting from falls. Deaths from motor vehicle accidents are a special problem for the youth of our country. In 1984, almost three fourths of all accidental deaths for persons age 15-24 resulted from motor vehicle accidents, and these deaths accounted for almost 40 percent of all deaths for that age group.

The National Safety Council has gathered statistics on deaths from motor vehicle accidents since 1913. Over this extended time, the number



of such deaths has climbed steadily, the years since World War II showing especially large losses. At the same time, however, there has been a steady increase in the number of drivers and motor vehicles on the nation's highways and a similar increase in the number of miles those drivers and vehicles travel each year. Consequently, the rate of motor vehicle deaths—whether related to drivers, vehicles, or miles traveled—has generally been declining. Nevertheless, the decline has not kept pace with the decline for other types of accidental death, and the absolute number of deaths from motor vehicle accidents each year is still a matter for national concern.

Although we identified many instances of automobile safety research—including numerous NHTSA studies using FARS—very little of that research discussed the changes in the characteristics of fatal accident statistics. Moreover, studies have compared specific fatal accident characteristics—such as trucks versus cars or male versus female drivers—but these studies have tended to have a narrow focus. In addition, because of the difficulty in obtaining accident-exposure information, only small amounts of information are available that compare accident fatality statistics to various measures of accident exposure, such as vehicle miles traveled, number of registered vehicles, or number of drivers. A NHTSA official's comments on a draft of this report stressed that the lack of good exposure data is one of the major impediments to highway safety analysis. Our report attempts to fill some of these gaps by presenting information that is (1) based on fatal accident trends, (2) extensive in the accident characteristics discussed, and (3) related, where possible, to measures of accident exposure. A complete discussion of the legislative history, accident data sources, and our scope and methodology is contained in appendix I.

Our Analysis

Our analysis of fatal accident data from 1975 through 1987 indicated an increase in such accidents from 1975 to 1980, a decrease through 1982-83, and then an increase again through 1987. We refer throughout to this general increasing-decreasing-increasing pattern of fatalities as the overall trend. This pattern applies to many of the general fatality statistics we present, and, in all cases, it serves as a convenient yardstick for comparison, so that our discussion concentrates principally on patterns that depart from the overall trend, with particular attention to departures that indicate a worsening situation. In particular, we highlight trends that, by 1987, had resulted in (1) a greater than 20-percent increase compared to 1975 or (2) a greater than 20-percent increase

compared to the low year of 1982-83 associated with the upturn in the overall trend.

Driver fatalities account for more than half of all motor-vehicle-related fatalities, and male fatalities dominate the fatality statistics, whether viewed as simple counts or adjusted for exposure in terms of fatality rates per million population. We also compared fatalities to other exposure measures—such as miles driven, drivers, and registered vehicles. The fact that these fatality rates have steadily declined suggests that the apparent increase in various fatal accident statistics since 1983 is most likely a function of increased motor vehicle activity rather than a decline in general motor vehicle safety. However, more sophisticated analyses of disaggregated statistics, which we plan to undertake in subsequent work, may indicate that some types of vehicles are, in fact, unambiguously safer than others. The female fatality rate for 16- and 17-year-olds has strongly influenced the overall rate for this age group since 1983. The fatality rate for females of this age group increased from a little over 170 per million population in 1982 to over 240 per million in 1987, an increase of about 40 percent. The 1987 rate was exceeded only by the 1980 rate, but there was not a great disparity between the two. The experience for males of this age group is not nearly as dramatic. Table 1 highlights other general fatality statistics that, by 1987, showed increases of 20 percent or more, either from the 1975 base year or from the low year associated with the upturn in the overall trend in 1982 or 1983. Additional information on general fatal accident trends is contained in appendix II.

Table 1: Highlights of General Fatal Accident Statistics[a]

Variable	Percent increase in 1987 Over 1975	Over 1982-83
Number of vehicles involved		
Three	48.29	40.15
Four	50.95	42.15
Five	106.67	69.09
More than five	91.30	100.00
One-vehicle accidents		
Minisize automobiles	138.45	15.55
Subcompact automobiles	171.79	39.37
Compact automobiles	617.37	195.07
Total small automobiles	221.97	54.95
Intermediate automobiles	69.07	
Van-based light trucks	49.29	26.31
Conventional light trucks	56.35	26.20
Total light trucks	55.29	26.21
Total trucks	40.68	
Motorcycles	37.23	

[a]Blank cells indicate that the percentage of change did not exceed 20 percent.

In addition to our analysis of overall fatality trends, we examined trends by various accident factors. We looked at factors associated with drivers (by age, gender, and use of safety restraints), vehicles (by type and size), and the roadway driving environment (by time of day and weather conditions). We found that the overall trend applies to many of the driver-related statistics discussed. One of the most revealing of these trends is the changing relationship between fatalities and safety restraint usage. Increased motor vehicle safety restraint use since 1979-80 appears to have saved the lives of many drivers and passengers. Further, the percentage of occupants not using safety restraints who were killed has continued to increase.

Our analysis also shows that the rate of involvement of women drivers in fatal accidents has increased more than 20 percent since 1975 and that this rate of increase applies to nearly all female age groups.

Drinking drivers are a very serious traffic safety problem. However, a NHTSA official pointed out that when analytical procedures are used to adjust for the large amount of missing data regarding the presence of drinking drivers, the results indicate that the percentage of drinking drivers in fatal accidents has been declining.

Table 2 highlights the driver-related statistics that, by 1987, showed increases of 20 percent or more, either from the 1975 base year or from the low year associated with the upturn in the overall trend in 1982 or 1983. See appendix III for an in-depth discussion of trends in driver-related statistics.

Table 2: Highlights of Driver-Related Fatal Accident Statistics[a]

Variable	Percent increase in 1987 Over 1975	Percent increase in 1987 Over 1982-83
Driver involvement rate		
By gender: Female	26.09	22.23
By age group		
Age 16-17		27.40
Male by age group		
16-17		20.55
Female by age		
16-17	50.78	59.87
18-20	35.71	26.03
21-25	27.79	26.59
Over 65	47.20	31.81
Speed of vehicles in mph		
36-45	29.54	
46-55	25.77	22.01
56-65	68.96	49.12
Over 65		24.42
Drivers not using safety restraint	26.42	22.10

[a]Blank cells indicate that the rate of change did not exceed 20 percent.

The types of vehicles involved in fatal accidents have changed over the years. The number of small cars involved in fatal motor vehicle accidents has increased more than 100 percent from 1975 through 1987; the number of light trucks and vans in fatal accidents has increased more than 50 percent in the same time. The numbers of fatalities in these types of vehicles show similar increases. However, both the rate of vehicle involvement in fatal accidents per number of registered vehicles and the number of fatalities per number of registered vehicles are still generally declining for these types of vehicles. Exceptions to the general decline are the rates for subcompact automobiles and conventional pickup trucks, which have been increasing since 1983. Even though accident involvement rates and fatality rates for small automobiles have been declining, they are still a matter of concern, since the rates are considerably higher than those of larger automobiles. While medium and

heavy trucks have one of the lowest fatality rates for vehicle occupants, they have one of the highest fatal accident involvement rates.

The average age of both automobiles and trucks has been increasing as it applies to both the number on the road and the age of vehicles involved in fatal accidents. However, in 1975 through 1987, the period of our study, vehicle age appears to have become less a factor in fatal accidents for automobiles than for trucks.

The only accidents that show trends different from the overall trend are rear-end collisions and noncollision accidents (such as overturns and fire, where no impact to the vehicle occurs throughout an accident). Both have increased more than 25 percent since 1982.

Table 3 highlights the vehicle-related statistics that, by 1987, showed increases of 20 percent or more, either from the 1975 base year or from the low year associated with the upturn in the overall trend in 1982 or 1983. Appendix IV contains additional information on vehicle-related trends.

able 3: Highlights of Vehicle-Related atal Accident Statistics[a]

	Percent increase in 1987	
	Over 1975	Over 1982-83
Accident involvement by automobile size		
Minisize	150.73	
Subcompact	193.13	54.12
Compact	751.11	228.37
All small automobiles	257.15	69.57
Intermediate automobiles	116.72	
Fatalities by automobile size		
Minisize	134.36	
Subcompact	170.61	46.30
Compact	672.64	222.94
All small automobiles	224.13	59.03
Intermediate automobiles	102.30	
Accident involvement by truck type		
All light trucks	69.57	31.00
All trucks	51.58	23.15
Number of fatalities by truck type		
All light trucks	63.87	32.59
All trucks	47.05	25.85
Other vehicles involved		
Motorcycles	24.41	
Buses		22.49
Fatalities in other vehicles		
Motorcycles	26.40	
Buses		28.57
Other		31.85
Deaths by initial impact of accident vehicles		
Noncollision		29.49
Side	20.70	
Rearend	59.73	
Other		46.90
Deaths by principal impact of accident vehicles		
Noncollision		29.45
Rearend	65.23	41.97

[a]Blank cells indicate that the rate of change did not exceed 20 percent.

While the numbers of fatal accidents under various environmental conditions reflect the effects of those conditions within any particular year, in most cases we did not find that they caused patterns to deviate from the overall trend. Exceptions include some of the specific areas of the Subcommittee's concern—namely, traffic controls, freeway accidents

and freeway signs, roadside hazards, and narrow bridges. The number of fatal accidents related to roadside hazards and narrow bridges appears to be steadily declining. Accidents where only "yield"-type traffic controls exist are on the increase. Freeway accidents have increased, especially where no traffic controls are present (more than a 15-percent increase since 1982), but fatal accidents have increased most on local, county, and other roads. We were not, however, able to adjust these data by exposure measures, because we could not obtain annual data reflecting any changes in travel patterns on these roads. Table 4 highlights the environment-related statistics that show increases of 20 percent or more, either from the 1975 base year or from the low year associated with the upturn in the overall trend in 1982 or 1983. Additional environment-related trend statistics are contained in appendix V.

Table 4: Highlights of Environment-Related Fatal Accident Statistics[a]

	Percent increase in 1987	
Variable	**Over 1975**	**Over 1982-83**
Limited access roadway	25.40	
Stop signals		22.10
Yield traffic controls	43.42	
Some freeway sign controls[b]		30.38
Sleet	48.75	
Daytime		20.10

[a]Blank cells indicate that the rate of change did not exceed 20 percent.

[b]Base year is 1981.

With regard to specific Subcommittee concerns, our review disclosed the following.

Narrow bridges have not been a factor in many fatal accidents, and the number of such accidents has been steadily decreasing.

Accidents tend to follow the overall trend, whether or not traffic controls are present; only roadways involving yield signs show increases in fatal accidents. Most accidents occur where no traffic controls are present. Accidents where existing traffic controls were not functioning have always been small in number.

Over 80 percent of all fatal accidents occur on dry roads. Accidents on both wet and dry roads tend to follow the overall trend.

Over the years, tires are being reported less and less as a contributing factor in fatal motor vehicle accidents. The number of vehicles in fatal accidents with tires as a contributing factor declined more than 40 percent from 1977 through 1987. The use of studded tires is not specifically reported in the FARS data base.

In most years, more than 90 percent of freeway accidents occurred where no special signs or other traffic controls existed. While we could not obtain data indicating the relative mileage for freeway locations, with and without signs, the increasing trend of freeway accidents is steeper when no freeway traffic controls exist.

FARS reports roadside hazards as a problem for very few fatal accidents, never totaling more than 400 a year, and the total number of such accidents decreased rather steadily from 1975 through 1981. As a consequence, the FARS system stopped collecting special data on hazards after 1981.

gency Comments

We provided drafts of this report to the National Center for Statistics and Analysis of NHTSA and met with an official of the center to discuss the study results. He expressed general agreement with the study results, making a few editorial suggestions that improve the clarity of the presentation. We incorporated these suggestions in the report where appropriate.

As agreed with your office, this report is being issued on an unrestricted basis. We are sending copies to the Administrator of the National Highway Traffic Safety Administration, to other organizations interested in highways and highway safety issues, and to others upon request.

If you have any questions or would like additional information, please call me at (202) 275-1854 or Dr. Michael J. Wargo, Director of Program Evaluation in Physical Systems Areas, at (202) 275-3092. Other major contributors to this report are listed in appendix VI.

Sincerely yours,

Eleanor Chelimsky
Assistant Comptroller General

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Tables

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Abbreviations

DOT	Department of Transportation
FARS	Fatal Accident Reporting System
GAO	U.S. General Accounting Office
NASS	National Accident Sampling System
NHTSA	National Highway Traffic Safety Administration

Background

The National Safety Council reports that, since 1948, there have been almost 100,000 accidental deaths per year and, on the average, almost half of those deaths resulted from motor vehicle accidents.[1] Motor vehicle accidents are the leading cause of accidental death overall and the leading cause of accidental death for persons age 1 to 74. For persons 75 and older, motor vehicle accidents are exceeded only by deaths resulting from falls. Deaths from motor vehicle accidents are a special problem for youths. In 1984, for persons 15-24, almost 40 percent of deaths from all causes resulted from motor vehicle accidents, and motor vehicle accidents accounted for almost three fourths of all accidental deaths for that age group (see table I.1).

Table I.1: Relationship of Accidental Deaths to Total Deaths in 1984

Age group	Total deaths from		Percent of total deaths	Total deaths from motor vehicle accidents	Motor vehicle deaths as a percent of	
	All causes	All accidents			Accidental deaths	Total deaths
Under 1 year	39,580	838	2.12%	161	19.21%	0.41%
1-4	7,372	2,814	38.17	977	34.72	13.25
5-14	9,076	4,198	46.25	2,263	53.91	24.93
15-24	38,817	19,801	51.01	14,738	74.43	37.97
25-44	112,484	25,498	22.67	15,036	58.97	13.37
45-64	404,568	15,273	3.78	6,954	45.53	1.72
65-74	476,570	8,424	1.77	3,020	35.85	0.63
75 and older	950,902	16,065	1.69	3,114	19.38	0.33
Total deaths	**2,039,369**	**92,911**	**4.56%**	**46,263**	**49.79%**	**2.27%**

The National Safety Council has gathered statistics on deaths from motor vehicle accidents as far back as 1913. There has been a rather steady climb in the number of such deaths since then, the years since World War II showing especially large losses. At the same time, however, there has been a steady increase in the numbers of drivers and motor vehicles on the nation's highways and a like increase in the number of miles those drivers and vehicles travel each year. Consequently, the rate of motor vehicle deaths—whether related to drivers, vehicles, or miles traveled—has generally been declining. Nevertheless, the rate of decline has not kept pace with the rate of decline for other types of accidental death, and the sheer number of deaths from motor vehicle accidents each year is still a matter for national concern.

[1] National Safety Council, Accident Facts 1988 Edition (Chicago, Ill.: 1988).

Legislative History

The Department of Transportation Act (Public Law 89-670), dated October 15, 1966, established the Department of Transportation (DOT) and gave to it the responsibilities under the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966. The Highway Safety Act of 1970 (Public Law 91-605) created the National Highway Traffic Safety Administration within the DOT and assigned to it the responsibilities for the National Traffic and Motor Vehicle Safety Act of 1966 and the portions of the Highway Safety Act of 1966 related to highway safety programs not otherwise assigned to the Federal Highway Administration. Since 1966, the Congress has passed several other laws that relate, either directly or indirectly, to highway safety. All the legislation related to highway safety addressed, to varying degrees, three basic areas related to highway safety—the motor vehicle, the vehicle driver, and the highway environment. Some of the specific concerns of this legislation are summarized in the table I.2.

Table I.2: Summary of Legislative Safety Concerns

Area	Statute (Public Law)	Year
Vehicle		
Promotion of safety in manufacturing vehicles	84–627	1956
Brake fluid standards	87–637	1962
Seat belt standards	88–201	1963
Motor vehicle safety standards	89–563	1966
Relationship between equipment performance and accidents and injury	89–563	1966
Vehicle registration, operation, and inspection	89–564	1966
Fuel economy standards	94–163	1975
Child safety seats	98–363	1984
Length and width of trucks	98–554	1984
Inspection of trucks	98–554	1984
Driver		
Study of speed limit enforcement and need for uniform safety and speed laws	84–627	1956
Driver registry	86–660	1960
Expanded driver registry	89–563	1966
Study of relationship between alcohol consumption and highway safety	89–564	1966
Improvement of driver performance	89–564	1966
National speed limit	93–239 and 93–643	1974
National minimum drinking age	98–363	1984
Environment		
Study of need for uniform speed limit	84–627	1956
Study of design and characteristics of highway	84–627	1956
Highway design and maintenance	89–564	1966
Surveillance to find high-accident locations	89–564	1966
Hazardous materials	93–633 and 98–559	1975, 1984

While safe vehicles are important to motor vehicle safety, research conducted after the 1966 primary safety legislation on motor vehicles suggests that other factors may be more important. In a 1979 Indiana University study, performed under a contract from NHTSA, the researchers concluded that human factors were the leading causes of automobile accidents (93 percent), followed by highway environment (34 percent) and vehicle factors (13 percent).[2] Most of the vehicle-related factors involved vehicle deterioration rather than vehicle design, and they could have been avoided with proper inspection and maintenance procedures.

[2]J. R. Treat et al., Tri-Level Study of the Causes of Traffic Accidents (Bloomington, Ind.: Institute for Research and Safety, Indiana University, 1979). Figures add to more than 100 percent since multiple factors were present in some accidents.

This study would seem to call for directing more future safety efforts toward preparing better drivers and improving the driving environment. The study also reinforces a bifurcation in highway safety research between crash avoidance measures and occupant protection measures; the former focus on vehicle control while the latter focus on crash energy management.

Objectives, Scope, and Methodology

While the total number of highway deaths has been declining over the last 15 years, the aggregate statistic hides upward trends of selected components. The objectives of this report are to identify and describe the changing composition of the nation's highway fatality toll. We focus on fatality trends over time and how these trends compare or contrast with safety policy as it relates to the driver, the vehicle, and the roadway environment. We describe only the trends that are derivable from the FARS data base maintained by NHTSA and related measures of exposure to fatal accidents.[3] We do not attempt to explain causes for trends or to determine the interaction of various elements included in the FARS data base. We also do not consider the effects of such developments as helicopter evacuation and hospital trauma units on fatalities.

In developing this report, we used the annual computerized FARS data base maintained by NHTSA. We present results developed from the FARS data base for 1975 through 1987, using the three basic FARS subfiles—the accident file, the person file, and the vehicle-driver file. These files include data on about 41,000 fatal accidents per year, about 60,000 vehicles per year involved in those accidents, and about 110,000 persons per year involved as vehicle occupants, as pedestrians, or in other roles. We recoded some of the data to meet our needs (for example, age categories), and we recoded other data (for example, vehicle size) from input from NHTSA. Data to compute exposure rates came from various sources. Driver registration data were not readily available to satisfy the breakdowns necessary for our analysis. Instead, we used population data, which we obtained from Bureau of the Census publications, that include only the U.S. resident population. Vehicle age data came from Motor

[3]The term "exposure," as used in traffic safety research, is the measure of the total magnitude of various categories of interest (for example, all drivers by age and gender, or the age, type, and size of all registered vehicles) that could be involved in fatal traffic accidents. Exposure rates compare the actual fatal traffic accident statistics that occur to these various universe sizes. Some common exposure measures are population, driver registration data, and vehicle registration data.

Vehicle Manufacturers Association publications, and vehicle registration data came from computer files maintained by NHTSA.[4]

Our review was made in accordance with generally accepted government auditing standards and included the tests we considered necessary to assure ourselves of the reliability of the FARS computer-based data.

Accident Data Sources

Fundamental to the purposes of NHTSA is the collection of accident data that can identify safety problems, suggest solutions, and provide an objective basis for evaluating the effectiveness of motor vehicle safety standards and highway safety countermeasures. To this end, NHTSA has developed and used various systems to collect data on motor vehicle accidents. The principal data collection systems NHTSA uses are FARS and the National Accident Sampling System (NASS). In this report, we use FARS data—created to analyze fatal accidents—for our analysis, since the sampling errors associated with NASS data are often too large to discern whether apparent trends over time are legitimate.

FARS was conceived, designed, and developed by the National Center for Statistics and Analysis of NHTSA to provide, through data on fatalities, an overall measure of highway safety. The system was also intended to identify traffic safety problems, suggest solutions, and help provide an objective basis for evaluating the effectiveness of motor vehicle safety standards and highway safety programs. An agency official commenting on a draft of this report stressed that FARS is an outcome data base, since a fatality must have occurred before an accident qualifies for inclusion. This official also stressed that because FARS is an outcome data base, it must be used with care to avoid overgeneralizing to all accidents from data biased toward fatalities. FARS is a census of all fatal motor vehicle accidents occurring throughout the nation.

After 3 years of system development, FARS became operational for calendar year 1975, when the 50 states, Puerto Rico, and the District of Columbia began collecting and assimilating fatal highway accident data. FARS data differ from some other fatal accident statistics such as those of the National Safety Council because of the definitions used for fatal accidents. To qualify for inclusion in FARS, an accident must involve a motor vehicle traveling on a road customarily open to the public and it must have resulted in the death of a person—whether an occupant of a

[4]Motor Vehicle Manufacturers Association of the United States, Inc., MVMA Motor Vehicle Facts & Figures '88 (Detroit, Mich., and Washington, D.C.: 1988), pp. 28-29.

vehicle or a nonmotorist—within 30 days of the accident. NHTSA adopted the 30-day requirement because studies show that 98 percent of all motor-vehicle-related fatalities occur within 30 days of the accident and because this allows expeditious reporting. Most other countries use the 30-day reporting period.

FARS collects data at three levels: (1) the accident level, containing data on accident characteristics such as location, time, day of week, number of vehicles involved, and descriptions of the road conditions; (2) the vehicle-driver level, containing data on each vehicle and driver involved in the accident such as the vehicle's description and how it was damaged and variables describing the driving history of the drivers involved; and (3) the person level, containing data on each person involved in the accident, such as age, degree of injury, use of safety restraints, alcohol involvement, and role (driver, passenger, pedestrian, and so on).

FARS data are collected by state employees. NHTSA has contracts with all 50 states, Puerto Rico, and the District of Columbia to provide the necessary information. NHTSA furnishes standardized data collection instruments, and state FARS analysts use sources such as state vehicle registrations, driver licensing and highway department files, and vital statistics and death certificates to gather the necessary information. As state FARS analysts enter the data into NHTSA's computerized central data file, the data are automatically checked on-line for range and consistency as part of FARS quality control.

The Contribution of This Report

While we have identified numerous citations of automobile safety research—including numerous studies performed by NHTSA using FARS—very little of that research discussed the changes in the characteristics of fatal accident statistics over time. Moreover, while studies on specific fatal accident characteristics--such as trucks versus cars or male versus female drivers—have been performed by others, these studies have tended toward a narrow focus. In addition, because of the difficulty in obtaining accident exposure information, little information is available that compares accident fatality statistics to various measures of accident exposure such as vehicle miles traveled, number of registered vehicles, or number of drivers. This report attempts to fill some of these gaps by presenting information that is (1) trend-based, (2) extensive in accident characteristics discussed, and (3) related, where possible, to measures of exposure to fatal accidents.

General Fatal Accident Statistics

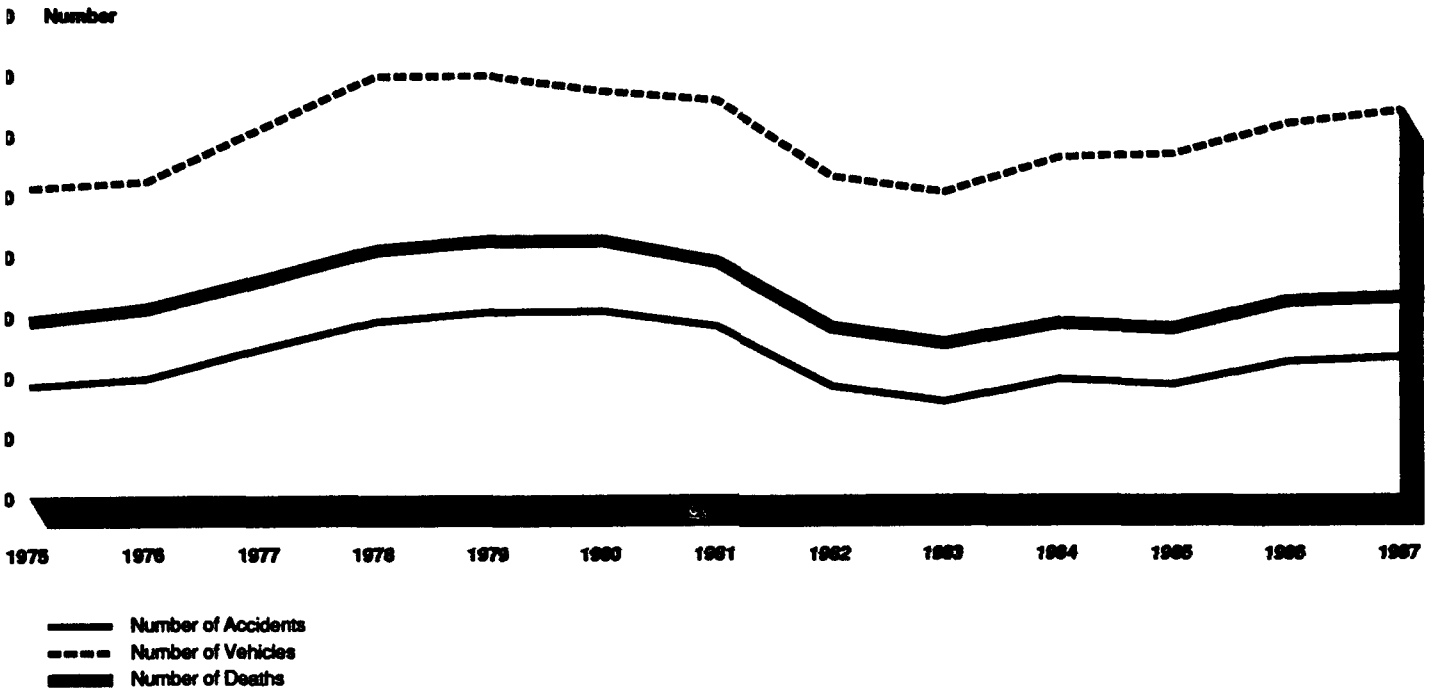
Introduction

Much has been written about the number of motor-vehicle-related fatalities over the past several years. The FARS system enables us to look at these fatalities and to study them in some depth. Data are available for 1975 through 1987. In this appendix, we discuss general fatal accident statistics that are not necessarily related to the specific elements of motor vehicle safety discussed in appendix I—namely, the driver, the vehicle, and the highway environment. We discuss the overall trend in motor-vehicle-related fatalities, some special aspects of the overall trend such as the roles of the persons killed (driver, passenger, pedestrian, and so on), and certain fatality rate information related to general measures of exposure to motor vehicle accidents.

Since 1975, the number of fatal motor vehicle accidents, the number of fatalities, and the number of motor vehicles involved in fatal accidents have reflected very similar patterns. All three trends show steady growth from 1975 through 1978 or 1979, followed by substantial declines through 1983 and then growth again through 1987. (See figure II.1.) The number of fatal motor vehicle accidents grew from about 39,000 in 1975 to about 45,000 in 1980-81 and then fell to about 38,000 accidents in 1983. Since 1983, the number of fatal accidents has again been on the increase, growing to about 41,000 in 1987. The number of fatalities grew from about 44,500 in 1975 to a high of about 51,000 in 1980 and 1981 before falling to about 43,000 in 1983. After 1983, the number of fatalities rose to about 46,500 in 1987. The number of vehicles involved in fatal accidents increased from about 56,000 in 1975 to about 65,000 in 1978 and 1979, fell to about 55,000 in 1983, and then rose again to about 62,000 in 1987.[1]

[1]We describe this pattern—increases through 1980, decreases through 1983, and then increases through 1987—as the overall fatality trend pattern. Whenever the term "overall trend" appears in this report, this general description of increase and decrease is implied.

ıre II.1: Number of Accidents, Vehicles, and Deaths in Fatal Accidents



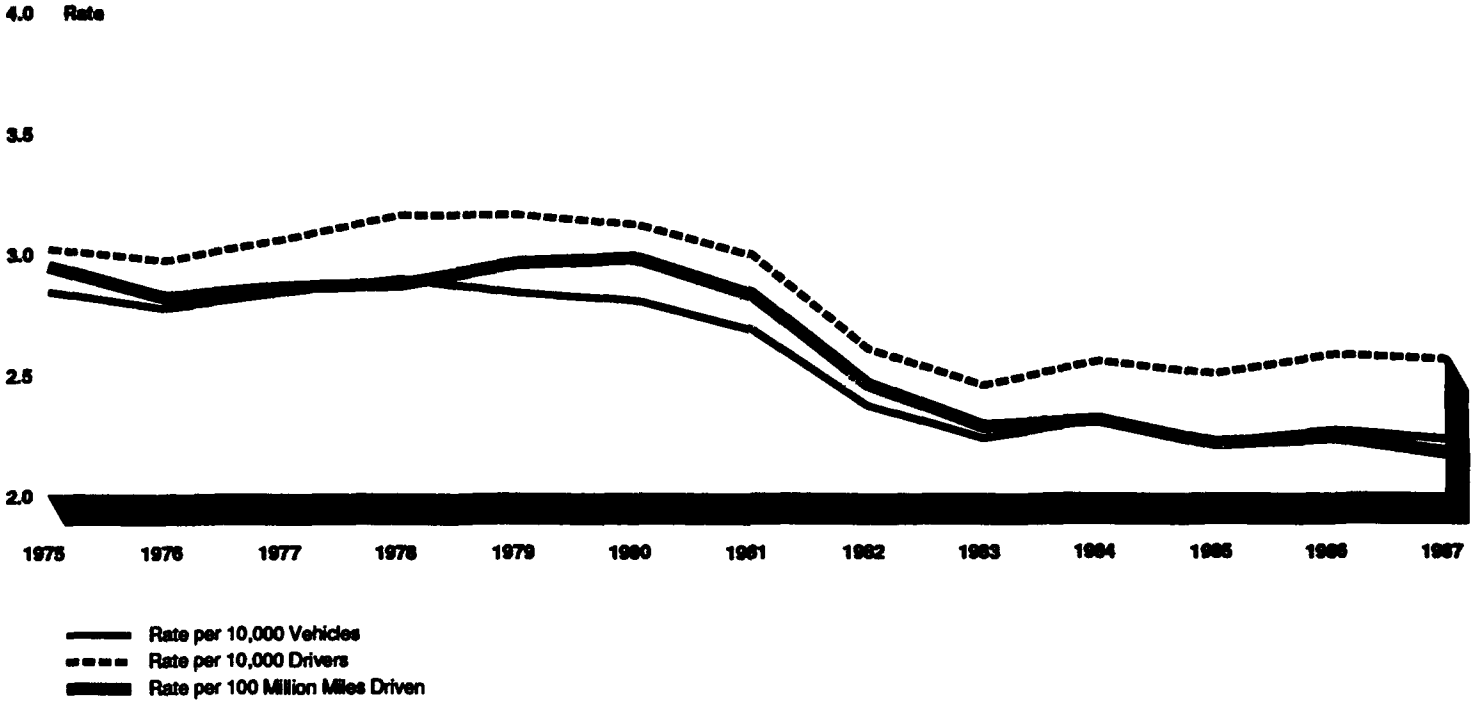
The comparisons of the three trends indicate the obvious—on the one hand, fatalities do not occur in all vehicles involved in fatal accidents and, on the other hand, some fatal accidents have more than one fatality. The comparisons would also seem to indicate that despite a generally better record than in the late 1970's, the occurrence of fatal accidents and related fatalities appears to be on the rise again. The apparent increase since 1983 is somewhat tempered when increase in exposure to motor vehicle accidents is considered. Since our analyses showed that the overall trend tended to be predominant, the following sections of this report concentrate on patterns that depart from the overall trend.

ıtal Accident Rate ·ends

To determine how much of the change in numbers of accidents is simply a reflection of a larger number of motor vehicles being on the road, we compared the numbers of fatal motor vehicle accidents and fatalities to three generally accepted units of exposure to such accidents—namely, miles driven, the number of registered vehicles, and the number of registered drivers. These comparisons show mixed results. While the fatal

accident rate per 100 million miles driven shows a continuing decline since 1980, fatal accidents per 10,000 vehicles and per 10,000 drivers show mixed patterns of increase and decrease since 1983. (See figure II.2.) The rate per 10,000 vehicles increased in 1984, decreased in 1985, increased again in 1986, and then decreased again in 1987. While the 1985 rate was lower than that for 1983, both the 1986 and 1987 rates were higher. The fatal accident rate per 10,000 drivers has generally been on the increase since 1983, with the exception of slight decreases in 1985 and 1987.

Figure II.2: Fatal Accident Rate Trends

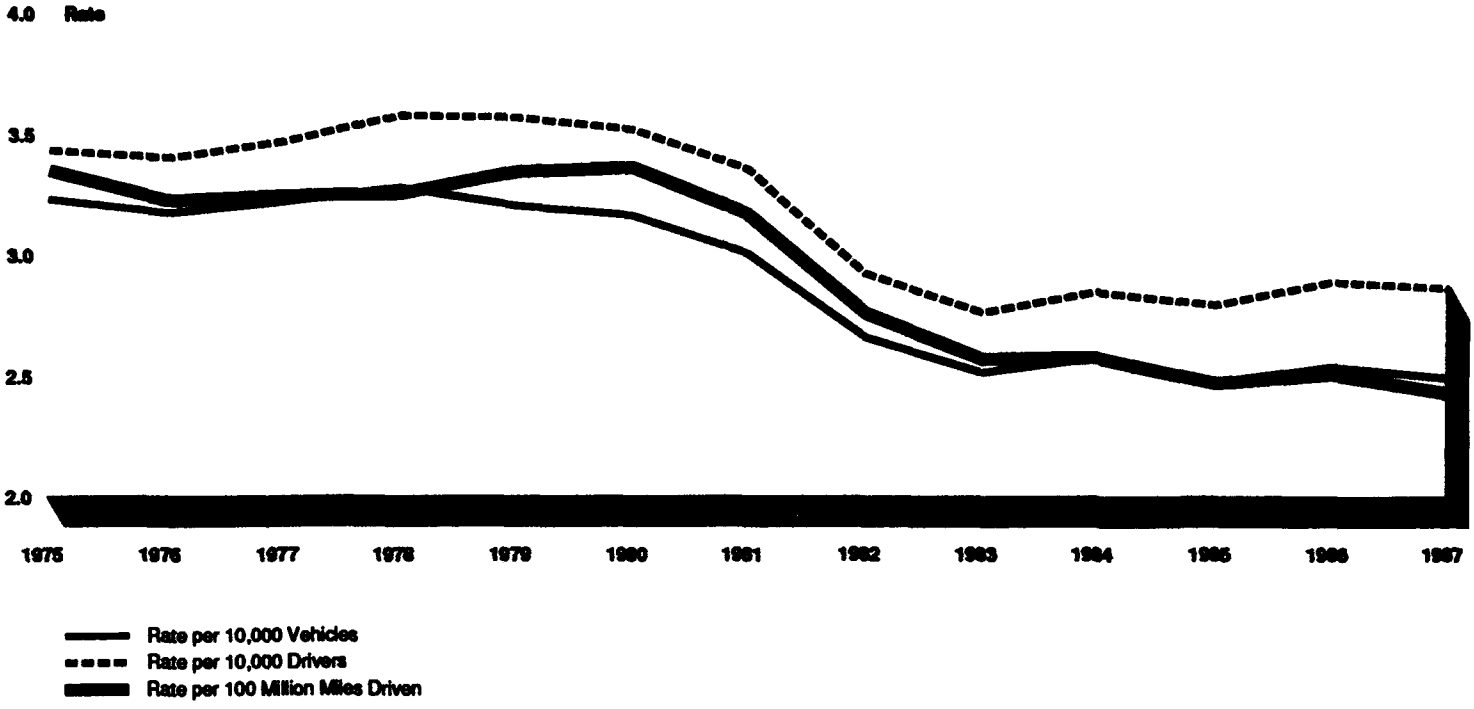


Source: Partial data from National Safety Council, Accident Facts 1988 Edition (Chicago, Ill.: 1988).

Fatality Rate Trends

When only fatalities in fatal accidents are considered, similar patterns occur. (See figure II.3.) The fatality rate per 100 million miles driven has continued to decline, with the exception of a small increase in 1986, while the rates per 10,000 vehicles and per 10,000 drivers show mixed increase-decrease patterns after 1983.

Figure II.3: Fatality Rate Trends



Fatality Rates Per Million Population

Since we were not able to obtain data to group the nation's drivers by age and gender, we focused on the fatality rates per one million population to display any differences. The pattern of this fatality rate trend is basically the same as that of the overall trend. (See figure II.4.) Fatalities reached a high of almost 230 per million population in 1979, fell to a low of a little over 180 per million population in 1983, and increased to a rate of about 190 per million population in 1987. The fatality rate for males has been two and a half to three times as large as that for females. (See figure II.5.) In recent years, the fatality rate for females has shown a higher rate of growth than that of males. Despite this more rapid growth, however, the fatality rate for females was still less than half the rate for males in 1987. Since 1983, the overall fatality rate has increased about 5 percent; the rate for males, however, has increased less than 3 percent while the rate for females has increased 10 percent.

Figure II.4: Fatalities Per Million Population

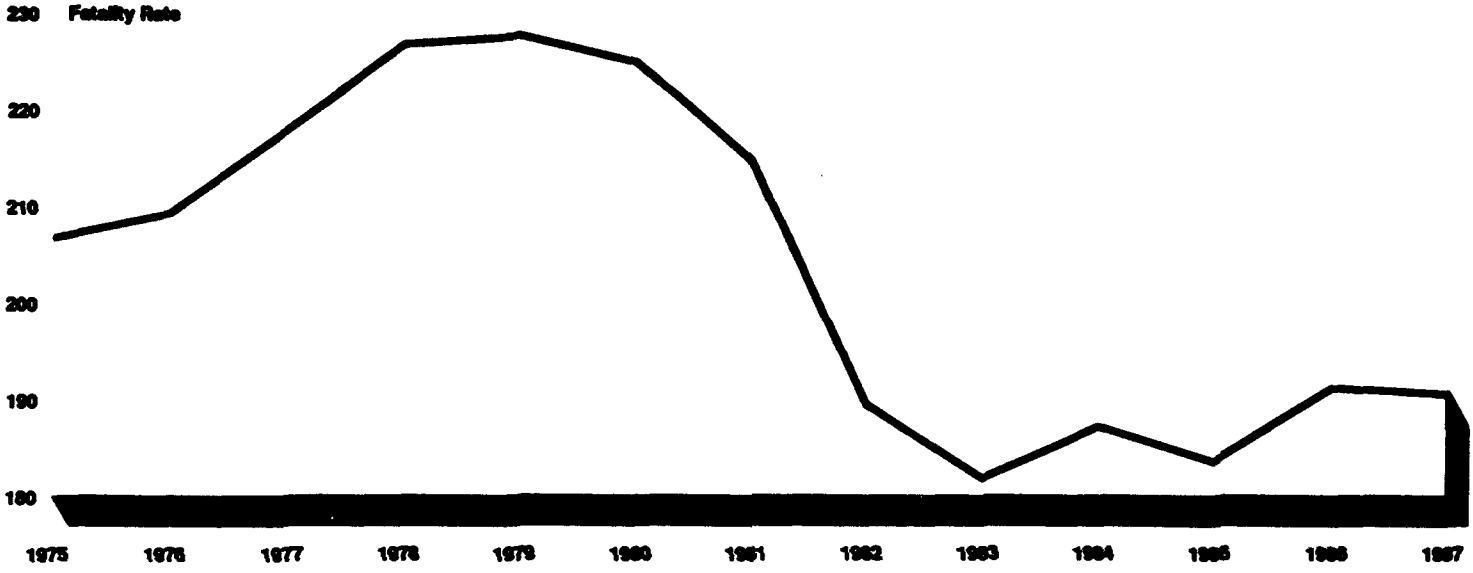
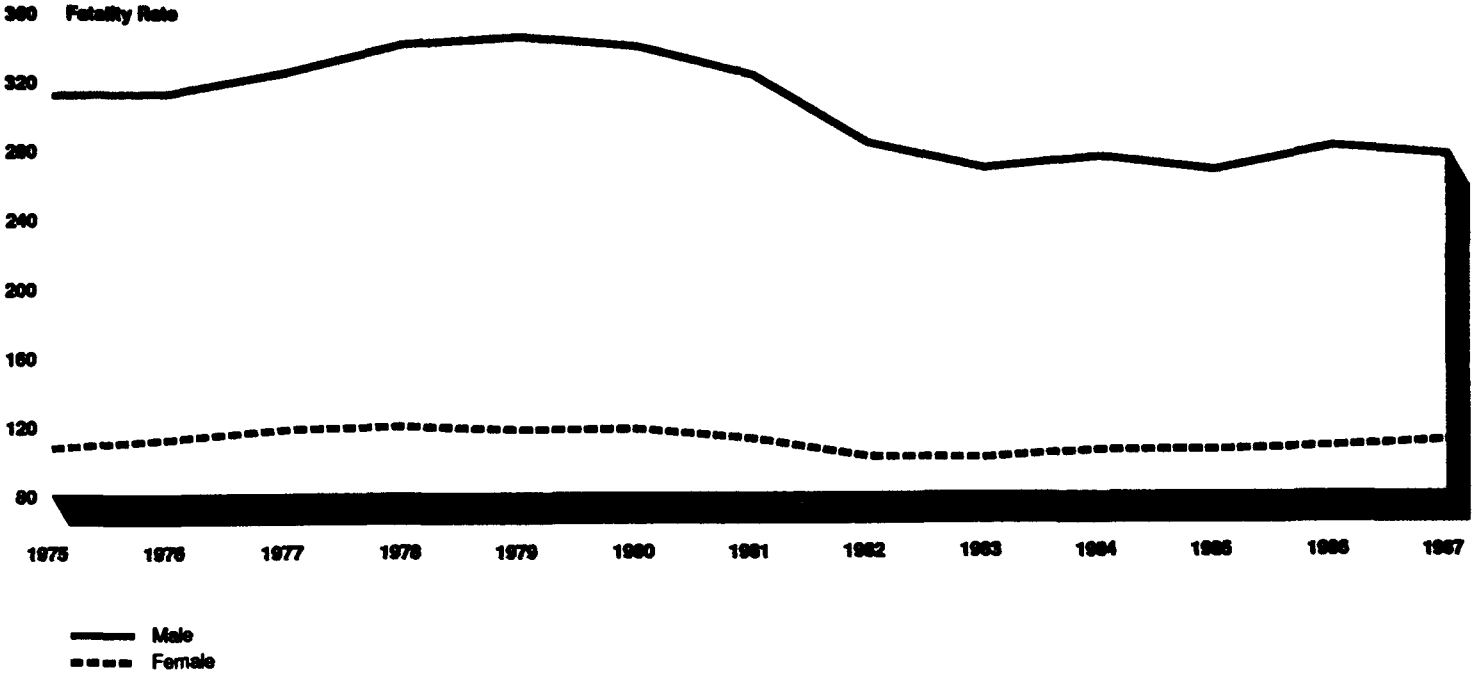


Figure II.5: Fatalities Per Million Population by Gender



There is also a wide divergence between age groups in fatality rates; however, fatality rate trends for all age groups tend to follow the overall trend.[2] The lowest fatality rate is that for people younger than 16—a rate that has never been over 100 per million population and that has decreased more than 20 percent since 1975. The highest fatality rate has consistently been that for ages 18 through 20, ranging from 414 to 542 per million population.

The only aspect of the trends themselves that appear worthy of special comment is the experience of 16- and 17-year-olds and those over 65 since 1983. Since 1983, the fatality rate for 16- and 17-year-olds has increased from 301 per million population to 352 per million population, an increase of about 17 percent. At the same time, the rate for those

[2]We used the following age groups: (1) younger than 16, (2) 16-17, (3) 18-20, (4) 21-25, (5) 26-50, (6) 51-65, and (7) older than 65. While our analyses show that fatality rates per million population declined steadily for smaller components of the 26-50 age bracket, this bracket is narrower than that used in similar analyses of rates per population by NHTSA. Moreover, analyses based on the 1983 National Personal Transportation Study show that mileage-based crash rates are fairly constant between the ages of 25 and 60. All our analyses based on age use this age breakdown.

older than 65 increased from 189 to 208 per million population, an increase of about 10 percent.

Fatality rates by age and gender taken together show that for all age groups, the rate for males is significantly higher than that for females. In fact, the fatality rate for males is a minimum of about 50 percent higher than that for females and, in many cases, is close to three times the rate for females. The fatality rates for males 16 through 20 are of special concern. The rate for 16- and 17-year-old males has never been lower than 410 per million population, and in 1978, it exceeded 570. The rate for 18- to 20-year-old males has never been below 600 per million population and in 1979 it was almost 840. The rates for females in the same age group never exceeded 250 per million population. The fatality rates for both males and females younger than 16 have declined dramatically over the years, even though they have increased slightly since 1983.

Nearly all the other age and gender fatality rate trends approximate the overall trend, but three exceptions related to females deserve mention. The female fatality rate for 16- and 17-year-olds has strongly influenced the overall rate for this age group since 1983. The fatality rate for females of this age group increased from a little over 170 per million population in 1982 to over 240 per million in 1987, an increase of almost 40 percent. The 1987 rate was exceeded only by the 1980 rate, but 1980 and 1987 were essentially the same. The experience for males of this age group is not nearly as dramatic. After reaching a low rate of 411 per million in 1983, the rate for males increased only a little over 10 percent through 1987. The fatality rate for females 51 through 65, while small in comparison to others, has increased almost 13 percent since 1982, and the rate for females older than 65 has increased about 17 percent since 1983. Increases for males of these age groups were only about 7 percent and 5 percent, respectively.

Fatalities Per Fatal Accident

As mentioned earlier, the number of motor vehicle fatalities exceeds the number of fatal motor vehicle accidents. To determine the effect that multifatality accidents exert on the overall number of motor vehicle fatalities, we analyzed both the average numbers of deaths per accident and the trends for various numbers of deaths per accident. Although there has been a general decline in the average number of fatalities per accident since 1976, the decline is somewhat misleading, since the rate varies so little in amount from the smallest to the largest. Most fatal accidents clearly have only one fatality. In 1987, over 90 percent of the

accidents had only one fatality, while accidents with two and three fatalities accounted for about 8 and 1 percent of the accidents. Less than 1 percent of the accidents involved four or more fatalities. (See table II.1.)

Table II.1: Fatal Accidents by Number of Fatalities Involved

Number of fatalities	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
One	35,019	35,451	37,819	39,870	40,608	40,747	39,853	35,356	34,382	36,000	35,562	37,207	37,526
Two	3,260	3,323	3,498	3,620	3,708	3,638	3,315	2,980	2,888	2,928	2,927	3,127	3,171
Three	633	668	637	657	667	654	620	530	499	504	513	525	534
Four	166	202	180	207	176	174	137	146	147	143	132	161	136
Five	44	61	48	58	37	44	53	48	37	34	36	47	45
More than five	30	41	29	20	27	27	21	32	23	22	25	23	23
Total accidents[a]	**39,161**	**39,747**	**42,211**	**44,433**	**45,223**	**45,284**	**44,000**	**39,092**	**37,976**	**39,631**	**39,196**	**41,090**	**41,436**

[a]Even though FARS is supposed to include only fatal accidents, the data files do include a few accidents for which zero fatalities were recorded. Therefore, these totals columns do not all add up.

Accidents with one, two, and three fatalities follow the overall trend. Fatal accidents with four or more fatalities show very erratic patterns and are generally small in number, the highest being 208 for accidents with four fatalities.

Fatalities by Person's Role

Who gets killed in fatal motor vehicle accidents? Have the trends in fatalities differed for various roles (drivers, passengers, pedestrians, and others)? Drivers constitute the majority of motor vehicle fatalities (about 58 percent in 1987) followed by motor vehicle passengers (about 25 percent), pedestrians (about 15 percent), and others (about 2 percent). (See table II.2.) Fatalities among drivers follow the overall trend. Passenger fatalities show a similar trend, although it is not as pronounced. Pedestrian fatalities show trends different from either driver or passenger fatalities. Other fatalities consist mostly of pedalcyclists and fewer than 100 other nonoccupant fatalities per year.

Table II.2: Fatalities by Role

Role	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Driver	23,652	24,500	26,170	28,283	28,863	28,816	28,200	24,690	24,138	25,589	25,337	26,630	26,831
Passenger	12,169	12,497	12,873	13,108	12,964	12,972	12,055	10,867	10,595	10,586	10,619	11,498	11,618
Pedestrian	7,516	7,427	7,732	7,795	8,096	8,070	7,837	7,331	6,826	7,025	6,808	6,779	6,746
All others	1,188	1,099	1,103	1,145	1,170	1,233	1,209	1,057	1,030	1,057	1,061	1,180	1,191
Total fatalities	**44,525**	**45,523**	**47,878**	**50,331**	**51,093**	**51,091**	**49,301**	**43,945**	**42,589**	**44,527**	**43,825**	**46,087**	**46,386**

Fatal Accidents by Number of Vehicles Involved

Just as most fatal motor vehicle accidents result in only one fatality, most fatal motor vehicle accidents also involve only one vehicle. (See table II.3.) In 1987, one-vehicle accidents accounted for 58 percent of the accidents involving fatalities. Two-vehicle accidents accounted for 36 percent, accidents with three or more vehicles about 6 percent. One-vehicle fatal accidents have consistently exceeded the second largest number—two-vehicle fatal accidents—by over 60 percent and have consistently exceeded all multivehicle accidents combined by over 40 percent.

Table II.3: Fatal Accidents by Number of Vehicles Involved

Number of vehicles	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
None[a]	567	618	668	752	886	862	934	0	0	0	0	0	0
One	23,651	24,100	24,890	25,768	26,374	27,424	25,898	23,851	23,048	23,697	22,875	24,275	24,159
Two	13,375	13,465	14,866	15,894	16,013	15,301	15,283	13,573	13,420	14,066	14,249	14,568	14,909
Three	1,290	1,322	1,445	1,681	1,604	1,392	1,533	1,365	1,371	1,520	1,675	1,816	1,913
Four	210	186	241	248	254	215	263	226	223	243	287	311	317
Five	45	33	72	60	61	49	53	55	61	68	71	82	93
More than five	23	23	29	30	31	21	36	22	33	37	39	38	44
Total accidents	**39,161**	**39,747**	**42,211**	**44,433**	**45,223**	**45,284**	**44,000**	**39,092**	**37,976**	**39,631**	**39,196**	**41,090**	**41,435**

[a]From 1975 through 1981, the FARS data files included cases in which no record of the number of vehicles was reported. These cases show zero vehicles in accidents and number fewer than 1,000 per year.

However, there are differences in the trends for one-vehicle versus multivehicle accidents. One- and two-vehicle fatal accidents show similar trend directions, but two-vehicle accidents have higher percentage swings. Accidents with three or more vehicles increased about 50 percent from 1975 though 1987. What is interesting about these accidents is that while they showed trend patterns similar to one- and two-vehicle fatal accidents in the early years, fatal accidents involving three or more

vehicles increased so much from 1983 onward that 1987 surpassed all previous years. However, since fatal accidents involving three or more vehicles are not large in number, the peak of 2,367 in 1987 is only about 350 more fatal accidents than the previous peak of 1978.

One-Vehicle Accidents

Since one-vehicle fatal accidents are by far the most frequent, we show the composition of such accidents in detail. Table II.4 quantifies the extent to which particular kinds of vehicles are involved in one-vehicle accidents.

Table II.4: Vehicles Involved in One-Vehicle Fatal Accidents

Type of vehicle	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Automobile													
Small	2,235	2,468	2,755	3,048	3,612	4,409	4,729	4,644	4,932	5,581	5,817	6,968	7,196
Intermediate	1,274	1,395	1,401	1,710	2,173	2,509	2,497	2,228	2,149	2,312	2,105	2,185	2,154
Full-sized	7,646	7,691	7,737	8,043	7,956	7,940	7,150	6,020	5,475	5,138	4,313	4,411	3,887
Size unknown	5,505	4,948	4,549	3,866	3,006	2,415	1,966	2,153	1,816	1,588	1,490	1,248	1,391
Total	**16,660**	**16,502**	**16,442**	**16,667**	**16,747**	**17,273**	**16,342**	**15,045**	**14,372**	**14,619**	**13,725**	**14,812**	**14,628**
Trucks													
Van-based light	566	518	644	783	886	911	837	740	669	684	695	705	845
Conventional light	3,223	3,639	3,925	4,389	4,646	5,110	4,769	4,077	3,993	4,203	4,320	4,733	5,039
Medium and heavy	1,163	1,350	1,443	1,573	1,574	1,423	1,336	1,081	1,205	1,259	1,160	1,162	1,084
Total	**4,952**	**5,507**	**6,012**	**6,745**	**7,106**	**7,444**	**6,942**	**5,898**	**5,867**	**6,146**	**6,175**	**6,600**	**6,968**
Motorcycles	1,276	1,357	1,721	1,876	2,047	2,238	2,102	1,965	1,927	2,052	2,049	2,041	1,751
Buses	158	142	150	147	153	156	155	118	130	125	124	115	110
Other vehicles	605	592	565	333	321	313	357	825	752	755	802	707	702
Total vehicles	**23,651**	**24,100**	**24,890**	**25,768**	**26,374**	**27,424**	**25,898**	**23,851**	**23,048**	**23,697**	**22,875**	**24,275**	**24,159**

Automobiles and Trucks

As might be expected, automobiles are by far the most likely vehicles to be involved in one-vehicle fatal accidents. More automobiles have been involved in one-vehicle fatal accidents than all other vehicle types. However, the difference in such accidents between automobiles and trucks has been narrowing somewhat in recent years. In 1975, automobiles (about 70 percent of the total) were involved in about three and a half times as many one-vehicle fatal accidents as trucks (about 20 percent); by 1987, automobiles (about 60 percent of the total vehicles) were less involved in such accidents, and trucks (almost 30 percent) were much more involved, so that the number of automobiles involved in one-vehicle accidents was only about twice the number of trucks.

It is very apparent that the principal reason for the increase in truck involvement in one-vehicle fatal accidents was the increasing involvement of light trucks and vans.[3] In fact, except for 1983 and 1984, the involvement of medium and heavy trucks in one-vehicle fatal accidents has been on the decline since 1979. One-vehicle fatal accidents involving automobiles have also been generally declining since 1980, with the exception of increases in 1984 and 1986.

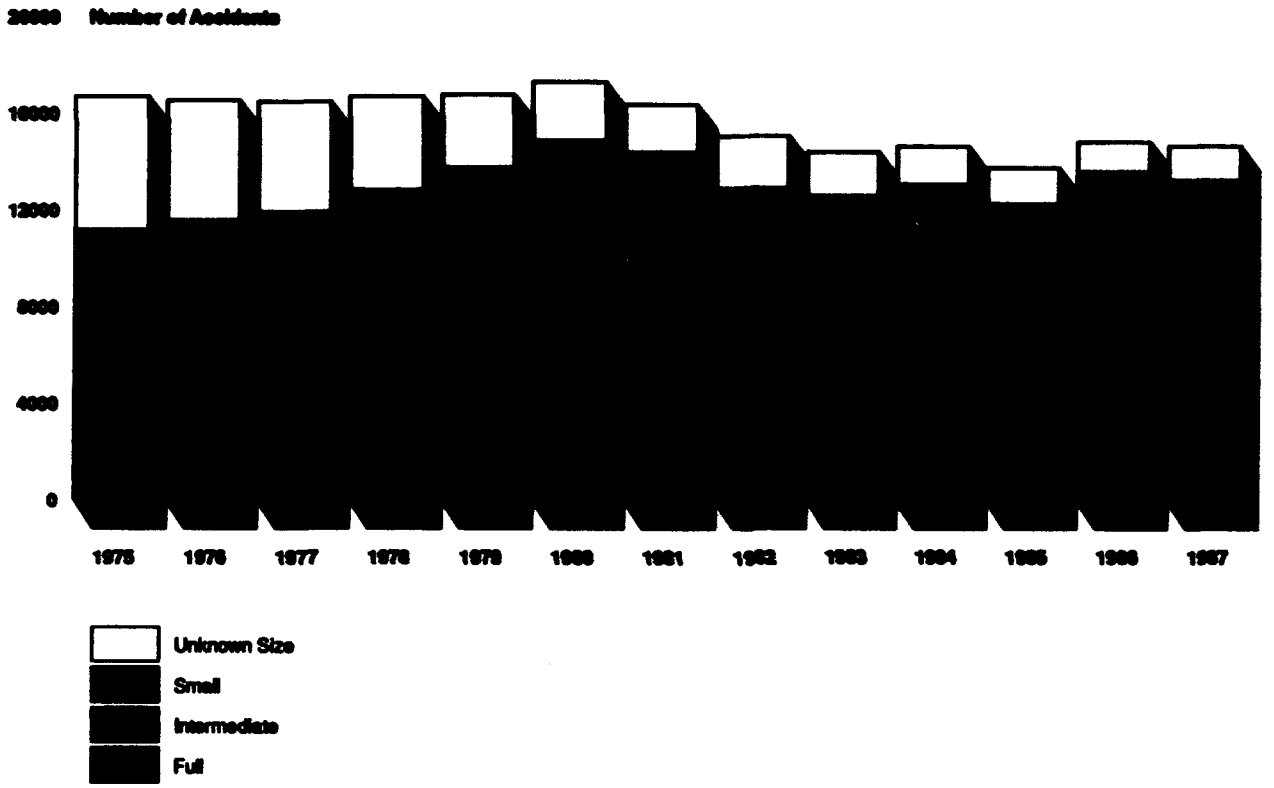
One-Vehicle Accidents and Automobile Size

While there are no unusual departures from the overall trend for total automobile involvement since 1983, automobiles in one-car fatal accidents by size of automobile give a different picture.[4] While the number of small cars involved in such accidents is on the increase, the involvement of full-size cars is on the decrease. (See figure II.6.) The involvement of intermediate cars in one-vehicle fatal accidents increased almost 100 percent between 1975 and 1980, but the number has declined more than 10 percent since then. In 1987, almost 50 percent of the automobiles involved in one-vehicle fatal accidents were small cars; about 15 percent were intermediate cars, and about 27 percent were full-sized cars.

[3]For this report, light trucks and vans include vehicles identified as van-based light trucks and light conventional trucks in the body type variable in the FARS data system. Specific vehicle weights were not considered.

[4]For this analysis, we used wheel base to determine automobile size. Full-size automobiles have wheel bases in excess of 114 inches. Intermediate cars have a wheel base of from 110 to 114 inches. Compact cars have 100-104-inch wheel bases, subcompacts 95-99 inches, and mini-size automobiles less than 95 inches.

Figure II.6: One-Vehicle Fatal Automobile Accidents by Automobile Size



Buses

One-vehicle fatal bus accidents have never been large in number; there were fewer than 160 in the peak year of 1975. From 1975 through 1981, fatal one-vehicle bus accidents varied up and down within a range of 20 of the 1975 peak year and then dropped almost 25 percent in 1982. After a slight increase in 1983 one-vehicle fatal bus accidents fell to 110 in 1987, the lowest total on record. In 1987, buses accounted for less than 1 percent of the vehicles involved in one-vehicle fatal accidents.

Motorcycles

One-vehicle fatal motorcycle accidents show a trend different from any other type of one-vehicle accident. The first year of our study, 1975, had the fewest one-vehicle fatal motorcycle accidents. One-vehicle motorcycle accidents increased dramatically, however, from 1975 through 1980, increasing about 75 percent. With the exception of 1984, however, one-vehicle fatal motorcycle accidents have been on the decline since 1980, but the number is still considerably higher than in 1975. In 1987, motorcycles accounted for about 7 percent of the vehicles involved in one-vehicle fatal accidents.

ther Vehicles

One-vehicle fatal accidents involving other vehicles declined steadily from 1975 through 1981.[5] In 1982, one-vehicle accidents involving other vehicles more than doubled, principally because of a dramatic increase in the number of vehicles reported with unknown body types. Since 1982, the number of other vehicles in one-vehicle accidents declined, reaching a low in 1987. In 1987, other vehicles accounted for about 3 percent of the vehicles involved in one-vehicle fatal accidents.

'he Age and Gender f Fatalities

Who is being killed in motor vehicle accidents and are there differing trends when fatalities are analyzed by age and gender? Table II.5 shows the distribution of motor vehicle accident fatalities by age and gender.

ible II.5: Fatalities by Age and Gender

ender	Age group	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
ale														
	Under 16	3,336	3,183	3,065	3,123	2,943	2,802	2,465	2,269	2,251	2,257	2,274	2,391	2,460
	16-17	2,161	2,299	2,386	2,504	2,452	2,258	2,030	1,722	1,567	1,580	1,532	1,861	1,780
	18-20	4,781	4,895	5,221	5,387	5,546	5,430	4,775	4,268	3,901	3,990	3,592	3,918	3,690
	21-25	5,513	5,730	6,251	6,765	7,089	7,176	6,883	6,134	5,700	5,894	5,876	6,033	5,608
	26-50	9,941	9,932	10,566	11,730	12,352	12,646	12,808	11,291	11,011	11,425	11,370	12,233	12,449
	51-65	3,673	3,786	3,865	3,858	3,876	3,823	3,689	3,232	3,099	3,200	3,141	3,078	3,272
	Older than 65	3,135	3,087	3,082	3,161	3,097	3,033	3,039	2,790	2,831	3,012	2,997	3,175	3,262
	Unknown age	135	126	191	203	233	224	241	173	139	183	177	167	107
tal		**32,675**	**33,038**	**34,627**	**36,731**	**37,588**	**37,392**	**35,930**	**31,879**	**30,499**	**31,541**	**30,959**	**32,856**	**32,628**
male														
	Under 16	1,899	1,921	1,966	1,893	1,789	1,700	1,515	1,438	1,336	1,367	1,438	1,448	1,444
	16-17	790	899	980	973	999	996	807	658	680	715	716	856	896
	18-20	1,240	1,437	1,514	1,608	1,536	1,496	1,461	1,334	1,264	1,242	1,237	1,233	1,199
	21-25	1,311	1,387	1,663	1,817	1,748	1,844	1,801	1,582	1,560	1,650	1,623	1,623	1,643
	26-50	3,065	3,101	3,309	3,545	3,750	3,876	3,819	3,538	3,633	3,872	3,827	3,933	4,384
	51-65	1,606	1,688	1,765	1,752	1,677	1,712	1,706	1,502	1,587	1,633	1,657	1,634	1,652
	Older than 65	1,865	1,984	1,951	1,917	1,913	1,965	1,954	1,942	1,977	2,171	2,269	2,399	2,489
	Unknown age	68	64	100	86	86	100	98	68	47	59	69	65	36
tal		**11,844**	**12,481**	**13,248**	**13,591**	**13,498**	**13,689**	**13,161**	**12,062**	**12,084**	**12,709**	**12,856**	**13,191**	**13,743**
known		6	4	3	9	7	10	210	4	6	7	10	40	15
tal fatalities		**44,525**	**45,523**	**47,878**	**50,331**	**51,093**	**51,091**	**49,301**	**43,945**	**42,589**	**44,257**	**43,825**	**46,087**	**46,386**

[5]Includes such vehicles as snowmobiles, nontruck farm equipment, all-terrain vehicles, nontruck construction equipment, go carts, fork lifts, city street sweepers, and unknown other vehicles.

Fatalities by Gender

Clearly more males than females are killed in motor vehicle accidents. In fact, almost three times as many males as females die in motor vehicle accidents each year. The principal difference in trends is that, while trends for both are similar to the overall trend, the number of female fatalities has increased much more rapidly than the number of male fatalities since 1983; 1987 was the peak year for female fatalities. By 1987, females accounted for about 30 percent of motor vehicle fatalities while males accounted for about 70 percent.

Fatalities by Age

Just as there were differences in the fatality trends for the genders irrespective of age, there were some differences in the trends by age irrespective of gender. The 16-17, 21-25, and 51-65 age groups tend to follow the overall trend. The other age groups are worthy of some discussion, however, because of certain departures from the overall trend. The under-16 age group did not follow the overall trend at all until 1983. Fatalities for this age group continually declined from 1975 through 1983 and then increased slightly through 1987. The 1987 level of fatalities is still about 25 percent below the peak level of 1975, however. The 18-20 group, while showing patterns similar to the overall trend in the early years, has not shown the general tendency to increase since 1983. Fatalities for the 26-50 group tended to follow the overall trend through 1983. However, the decline from the peak year in 1981 was not as dramatic as in other cases, and the number of fatalities for this age group in 1987—the peak year—is almost 30-percent higher than in 1975. Fatalities for the over-65 group show perhaps the most disturbing pattern. After showing slight declines in fatalities from 1975 through 1981, fatalities for this age group dropped about 5 percent in 1982. Unfortunately, since 1982, fatalities for this age group have increased more than 20 percent, reaching a peak in 1987.

Fatalities by Age and Gender

It is interesting to see how age and gender, considered together, illustrate departures from the overall trend while also pointing out any differences between male and female for each age group. The various age groups show the following differences, either from the overall trend or between genders.

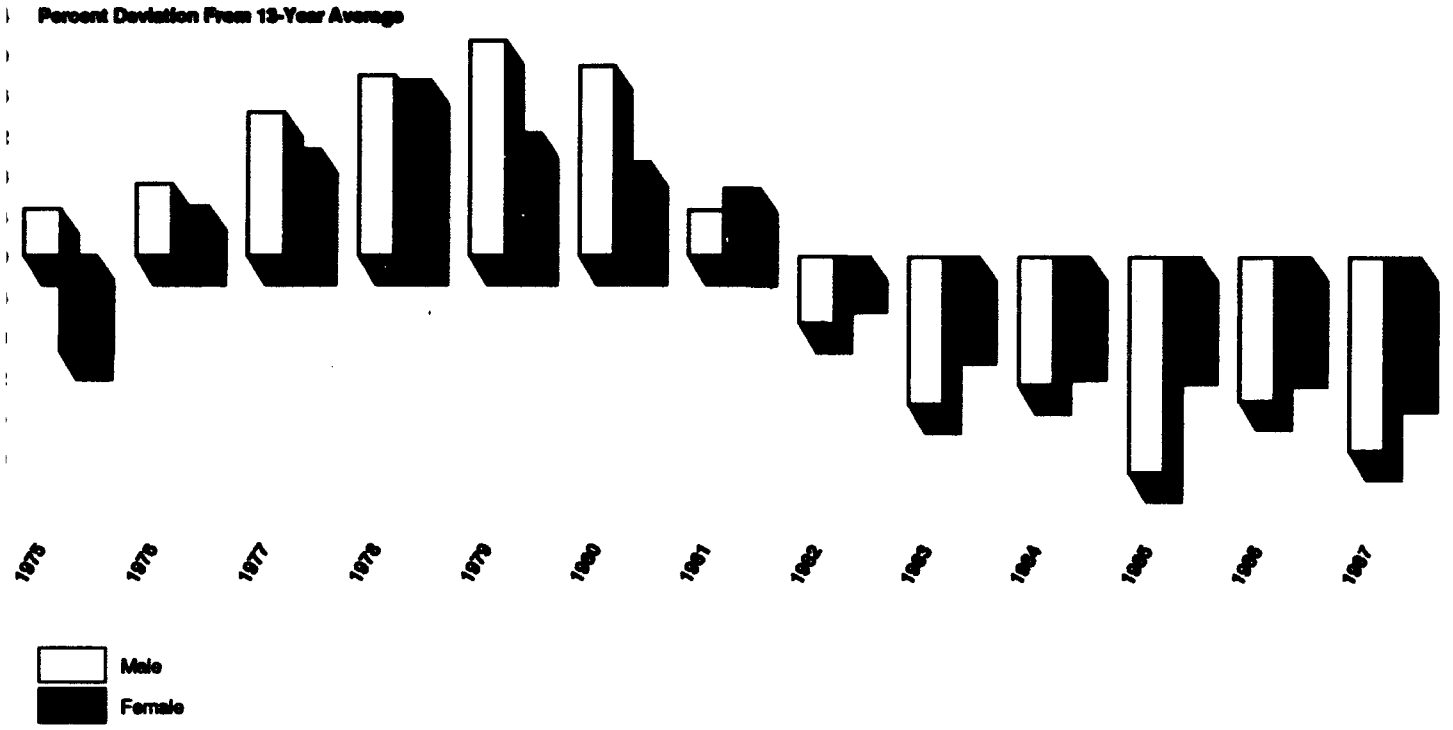
The group 16-17 shows a greater percentage increase in female fatalities in recent years than male fatalities. (See figure II.7.)

ure II.7: Fatalities for Ages 16-17 by Gender[a]

[a]Percentages are normalized as percentage deviations from the 13-year average of annual fatalities.

The group 18-20 shows similar trends for both genders but does not show the marked increases since 1983 that are characteristic of the overall trend. The principal difference between male and female is that while female fatalities continued to decline after 1985, male fatalities increased slightly after 1985. (See figure II.8.)

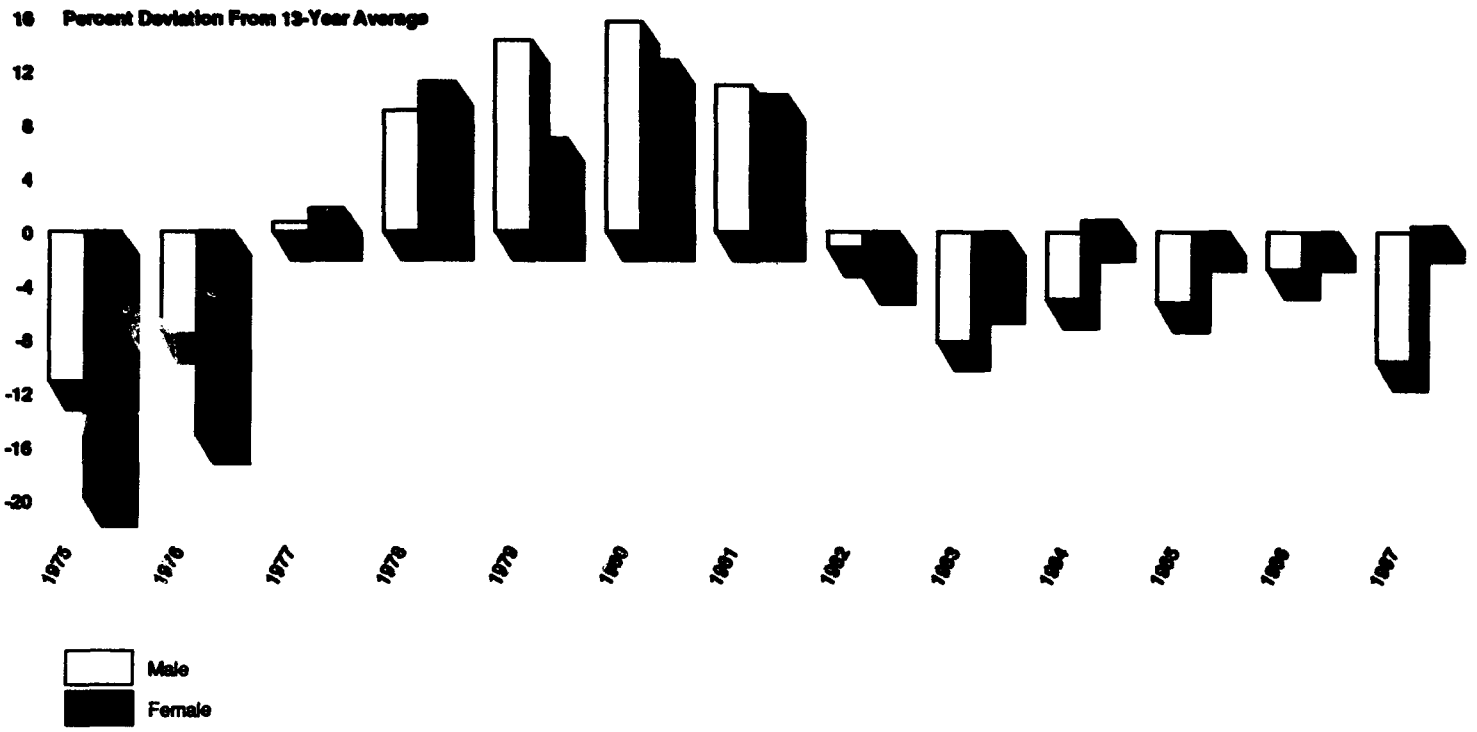
gure II.8: Fatalities for Ages 18-20 by Gender[a]



[a]Percentages are normalized as percentage deviations from the 13-year average of fatalities.

The group 21-25 shows significant trend differences since the 1980 peak year. The percentage decline in female fatalities from 1980 through 1987 was only about half the percentage decline in male fatalities for the same period. Moreover, while male fatalities in 1987 for this age group were only about 100 more than the previous low year of 1975, female fatalities for 1987 were still more than 25 percent higher than the 1975 low. (See figure II.9.)

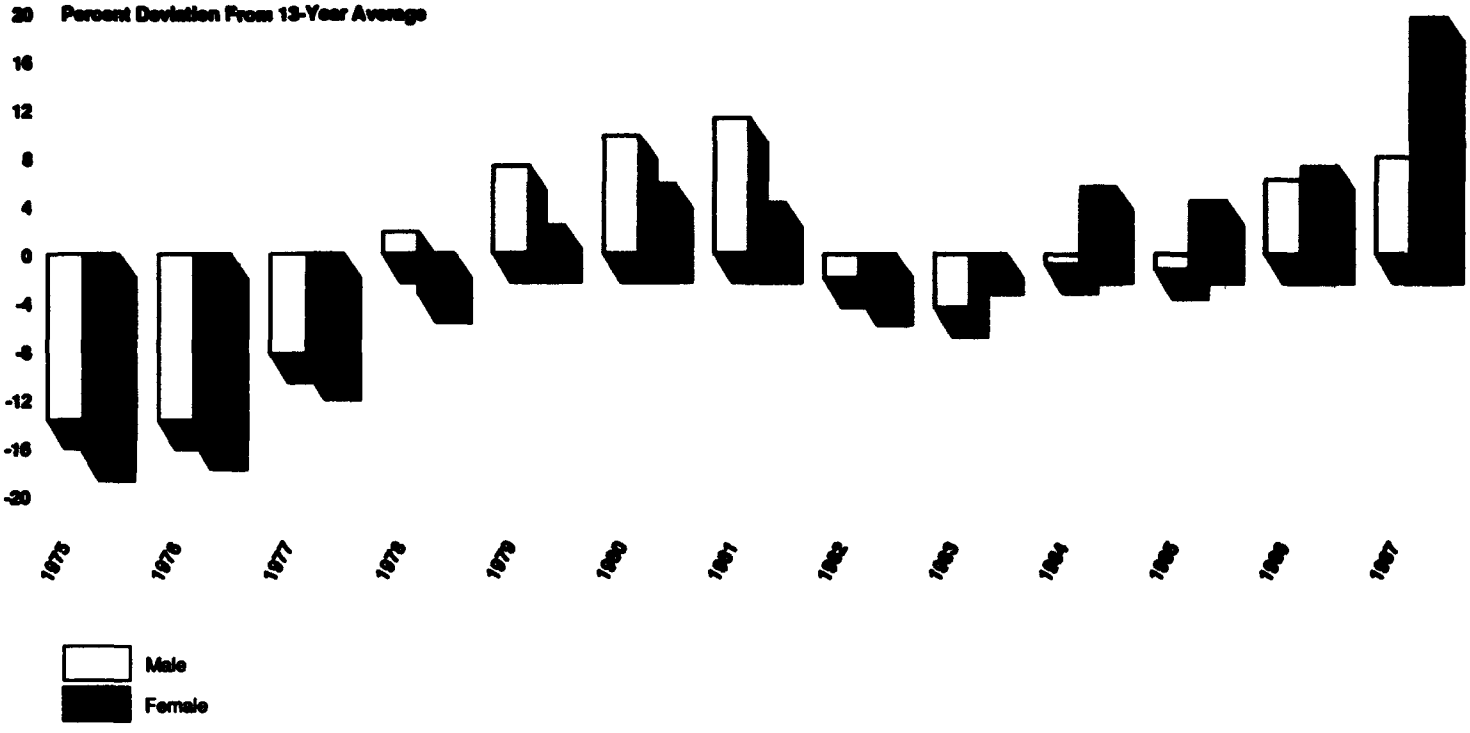
Figure II.9: Fatalities for Ages 21-25 by Gender[a]



[a]Percentages are normalized as percentage deviations from the 13-year average of annual fatalities.

The 26-50 group showed similar experiences for both male and female until 1980 or 1981. Thereafter, the difference was such that female fatalities reached a peak in 1987 that was about 13-percent higher than the previous peak of 1980; male fatalities in 1987 were still below the previous peak year. (See figure II.10.)

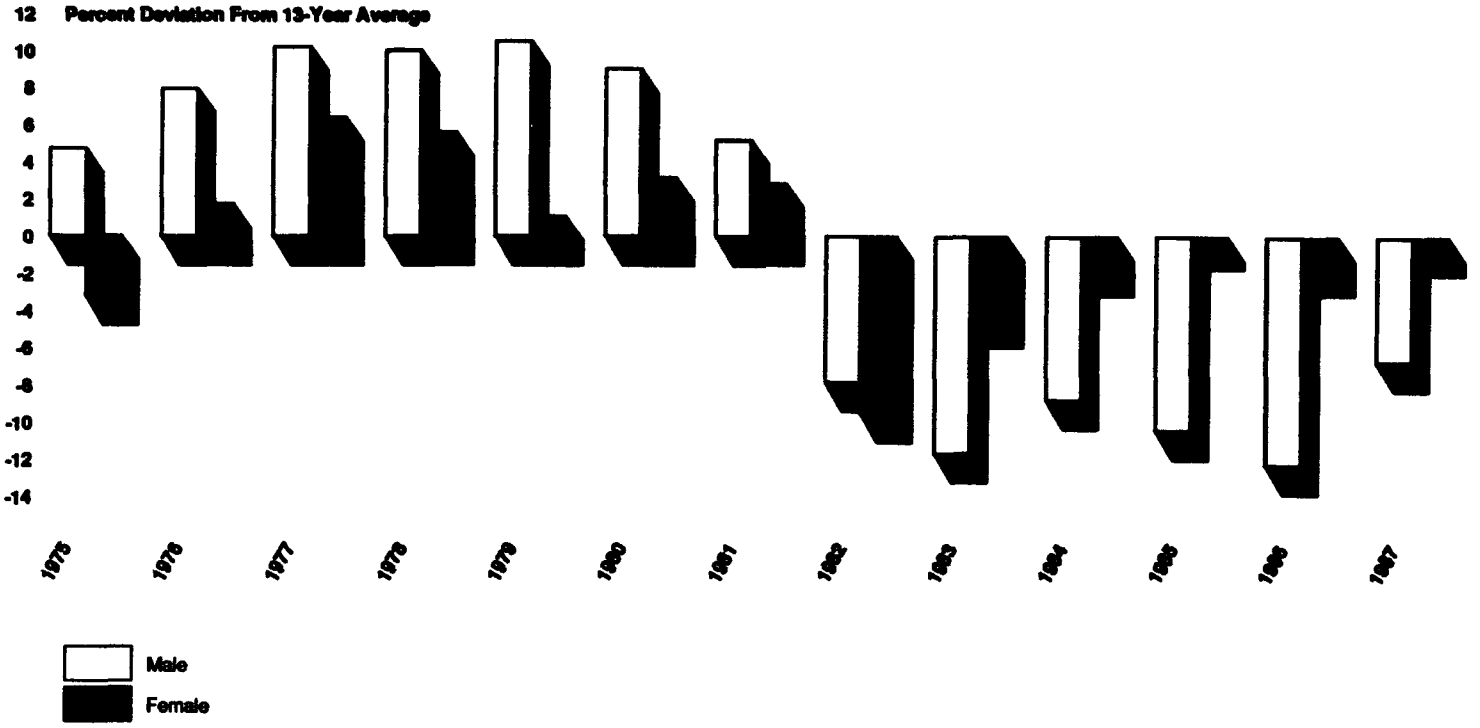
Figure II.10: Fatalities for Ages 26-50 by Gender[a]



[a]Percentages are normalized as percentage deviations from the 13-year average of annual fatalities.

The 51-65 group shows differences in fatality trends between males and females in recent years, after somewhat similar experiences in the early years. (See figure II.11.)

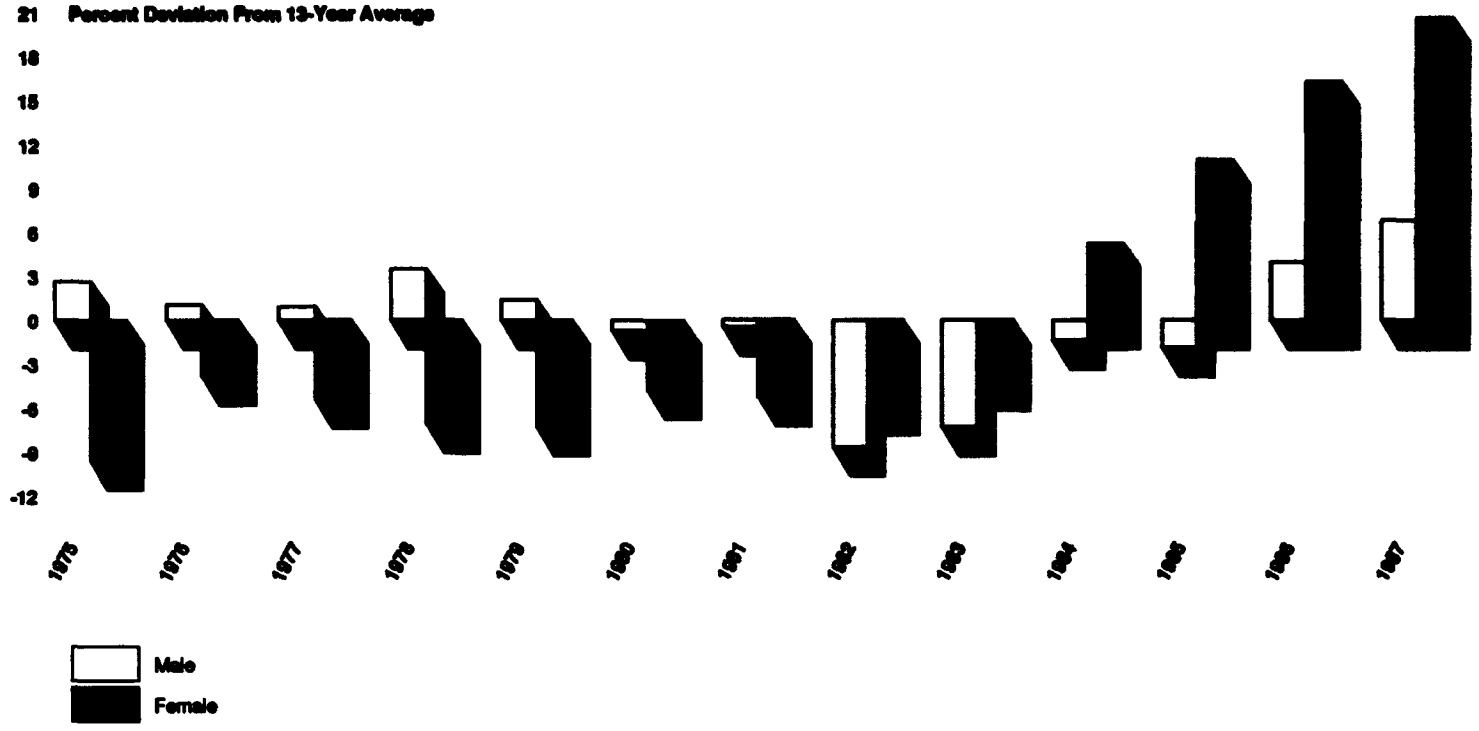
Figure II.11: Fatalities for Ages 51-65 by Gender[a]



[a]Percentages are normalized as percentage deviations from the 13-year average of annual fatalities.

The group older than 65 shows the greatest departure of all from the overall trend, especially for female fatalities. After varying little from 1975 through 1983, these increased about 25 percent from 1983 to 1987 and to a level over 30-percent higher than 1975. The percentage increase in male fatalities since 1982 was not nearly as large. (See figure II.12.)

Figure II.12: Fatalities for Ages 65 and Older by Gender[a]



[a]Percentages are normalized as percentage deviations from the 13-year average of annual fatalities.

Pedestrian Fatalities

Pedestrian fatalities show trends different from either driver or passenger fatalities. As with fatalities in general, we look at (1) fatalities by gender irrespective of age, (2) fatalities by age irrespective of gender, and (3) fatalities by age and gender taken together. Table II.6 shows the distribution of pedestrian fatalities.

Table II.6: Pedestrian Fatalities by Age and Gender

Gender	Age group	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Male														
	Under 21	1,694	1,633	1,549	1,621	1,621	1,535	1,339	1,272	1,163	1,149	1,070	1,097	1,029
	21-50	1,661	1,646	1,760	1,933	2,138	2,169	2,291	2,238	2,077	2,175	2,022	2,167	2,141
	Older than 50	1,831	1,786	1,930	1,841	1,824	1,786	1,689	1,534	1,452	1,597	1,484	1,418	1,542
	Age unknown	60	55	92	99	118	123	140	100	83	95	95	89	66
Total		**5,196**	**5,120**	**5,331**	**5,494**	**5,701**	**5,613**	**5,459**	**5,144**	**4,775**	**5,016**	**4,671**	**4,771**	**4,778**
Female														
	Under 21	877	874	852	821	777	725	684	651	578	560	571	521	495
	21-50	498	515	532	589	640	689	668	723	618	582	629	619	636
	Older than 50	921	892	976	855	927	989	923	777	834	829	904	834	816
	Age unknown	23	26	40	31	47	51	57	34	20	34	29	30	19
Total		**2,319**	**2,307**	**2,400**	**2,296**	**2,391**	**2,454**	**2,332**	**2,185**	**2,050**	**2,005**	**2,133**	**2,004**	**1,966**
Unknown		1	0	1	5	4	3	46	2	1	4	4	4	2
Total fatalities		**7,516**	**7,427**	**7,732**	**7,795**	**8,096**	**8,070**	**7,837**	**7,331**	**6,826**	**7,025**	**6,808**	**6,779**	**6,746**

Fatalities by Gender

Like motor vehicle fatalities in general, pedestrian fatalities for males are consistently more than twice the number for females. In 1987, males accounted for 71 percent of these fatalities, while females accounted for only 29 percent. When age considerations are ignored, both male and female pedestrian fatalities have showed substantial declines since their peak years of 1979 and 1980.

Fatalities by Age

Just as there were differences in the pedestrian fatality trends for male and female irrespective of age, there are also some differences in the trends by age irrespective of gender. We analyzed fatalities by three age categories—namely, (1) under 21 years old, (2) ages 21-50, and (3) over age 50. In 1987, these age categories accounted for 23, 41, and 35 percent of pedestrian fatalities, respectively. None of the age groups for pedestrian fatalities follows the overall trend very closely, but the patterns of divergence vary considerably. Pedestrian fatalities for persons younger than under age 21 have been steadily declining since 1975, only 1978 showing any increase at all. Unlike for the younger age group, the year 1987 for persons age 21 through 50 is not the lowest fatality year. Pedestrian fatalities for the 21- through 50-year-old age group show a rather steady pattern of increase from 1975 through 1981 but have decreased slightly since then. The 1987 total of almost 2,800 still exceeds the 1975 low year by over 30 percent. Pedestrian fatalities for

those older than age 50 have been generally declining, 1987 fatalities being about 15 percent less than in 1975.

Fatalities by Age and Gender

There is very little difference in trends for pedestrian fatalities between males and females under age 21. Pedestrian fatalities for both have been declining rather steadily, and the number in 1987 is only about 60 percent of the 1975 peak total for both. However, fatalities for pedestrians age 21 through 50 showed steady increases for both genders through 1980. Thereafter, female fatalities in this age group tended to follow the overall trend while male fatalities tended to decline. For the 50 and older age group, fatalities for both males and females have declined since 1975. However, while fatalities for females tend to follow the overall trend, fatalities for males again have generally continued to decline.

Conclusions

The overall trend—increases from 1975 through 1980, decreases through 1983, and then increases through 1987—applies to many, but not all, of the general fatality statistics discussed. Drivers are the greater part of motor vehicle fatalities, and male fatalities dominate the fatality statistics, whether viewed as simple counts or as fatality rates per million population. Relating fatalities to other exposure measures such as miles driven and numbers of drivers and registered vehicles suggests that not all but much of the apparent increase in various fatal accident statistics since 1983 is a function of increased motor vehicle activity rather than a decline in general motor vehicle safety. However, more sophisticated analyses of disaggregated statistics that we plan to use in subsequent reports may indicate that some types of vehicles are safer than others.

Driver-Related Statistics

As discussed in appendix I, motor vehicle safety legislation has been directed at three principal targets—the driver, the vehicle, and the driving environment. The FARS system was designed to collect data on these three areas. In this appendix, we discuss information obtained from FARS that pertains to drivers. We will discuss such items as driver-involvement rates, age and gender of drivers, vehicle speed (where known), drinking drivers, and the use of safety restraints.

Driver-Involvement Rates

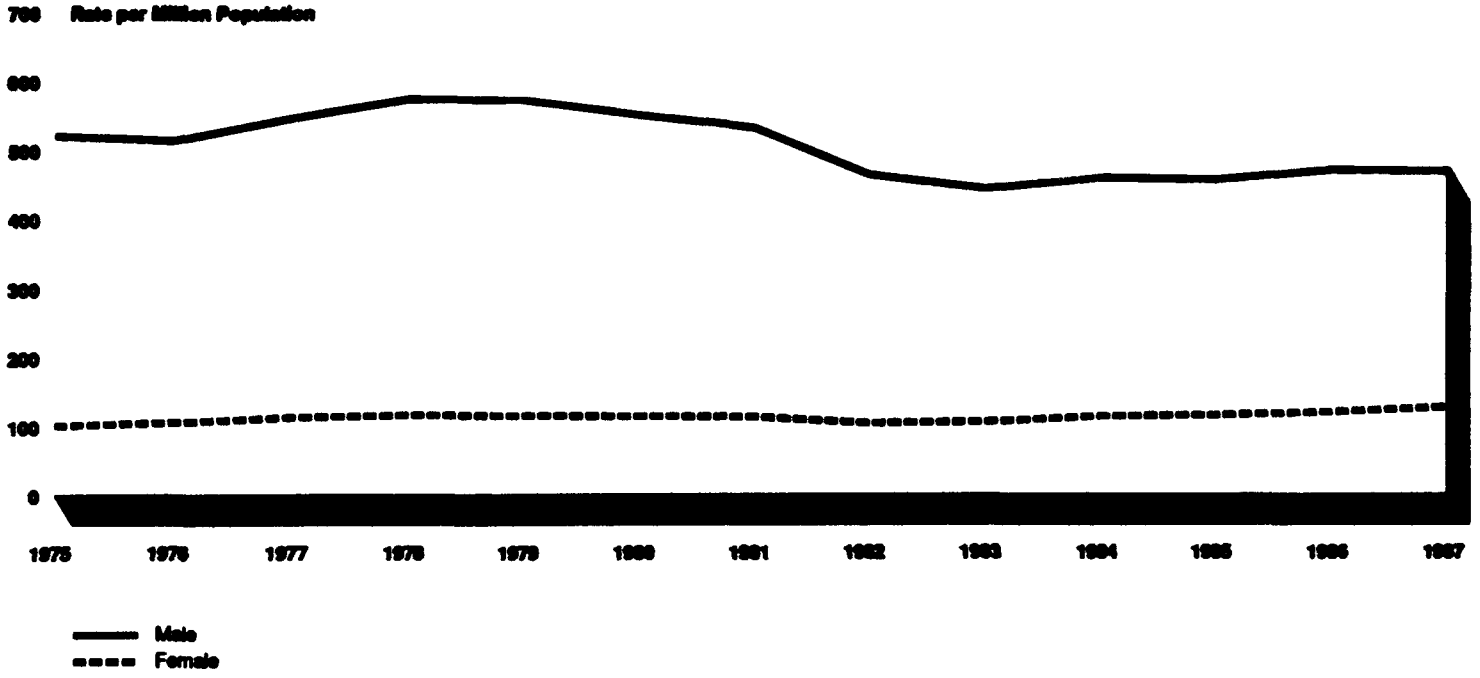
Analysis of driver involvement per million population gives a reasonable measure of whether there are real differences in fatal accident experience for various driver age and gender groups or whether they are merely a reflection of differences in population growth patterns.[1] The trend for the overall driver-involvement rate follows the overall trend.

Involvement Rates by Gender

The involvement of male drivers per million population is generally four to five times the female rate. (See figure III.1.) The involvement of males overall tends to follow the overall trend, while the involvement of females has been on the increase, especially since 1982. The involvement rate of females seemed to be following the overall trend through 1982, but since then, the female driver involvement rate has increased over 20 percent, and 1987 is the highest involvement rate for females on record. (See figure III.2.)

[1]We used population rather than number of registered drivers as the measure of exposure, since the disaggregation of registered drivers by age and gender is not available for all years.

Figure III.1: Driver Fatal Accident Rates by Gender



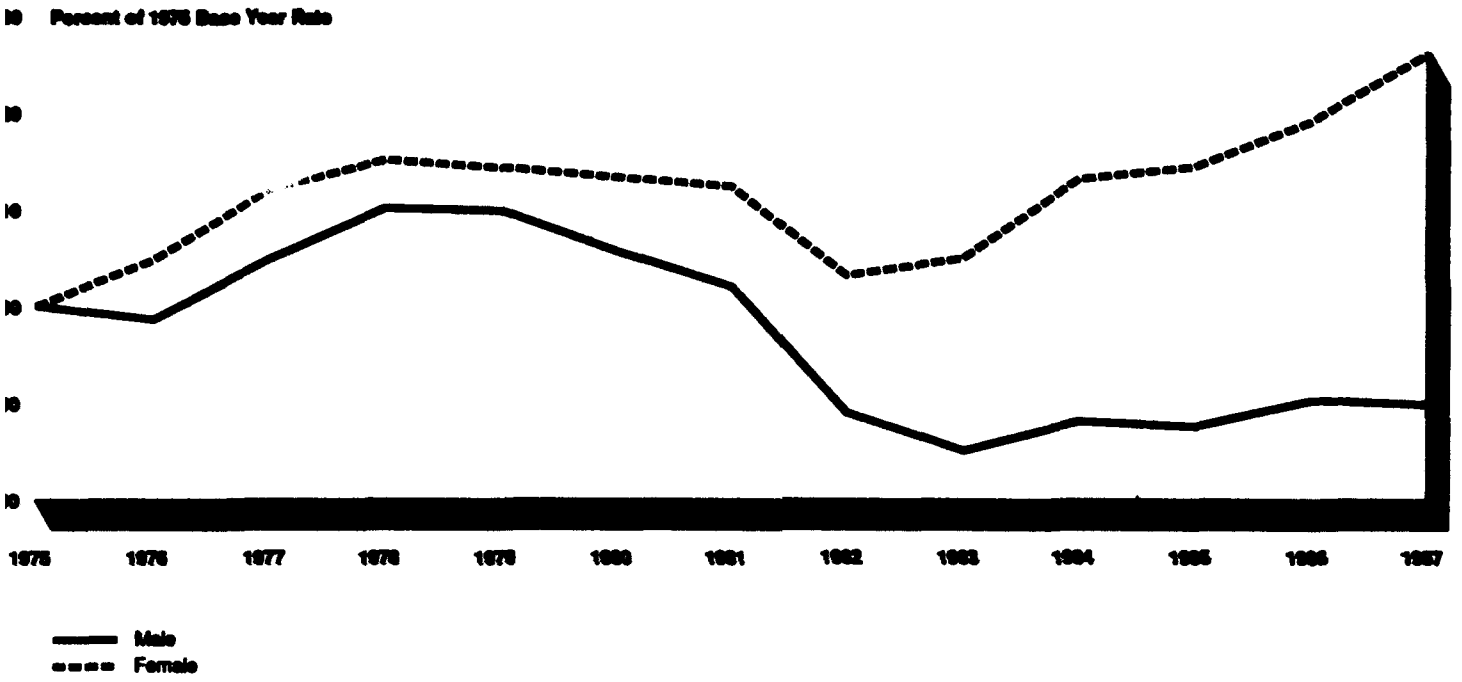


Figure III.2: Driver Fatal Accident Rates Related to 1975 Base Year by Gender[a]

[a]Percentages are the relation of the number of drivers involved in fatal accidents each year to the number of drivers involved in 1975.

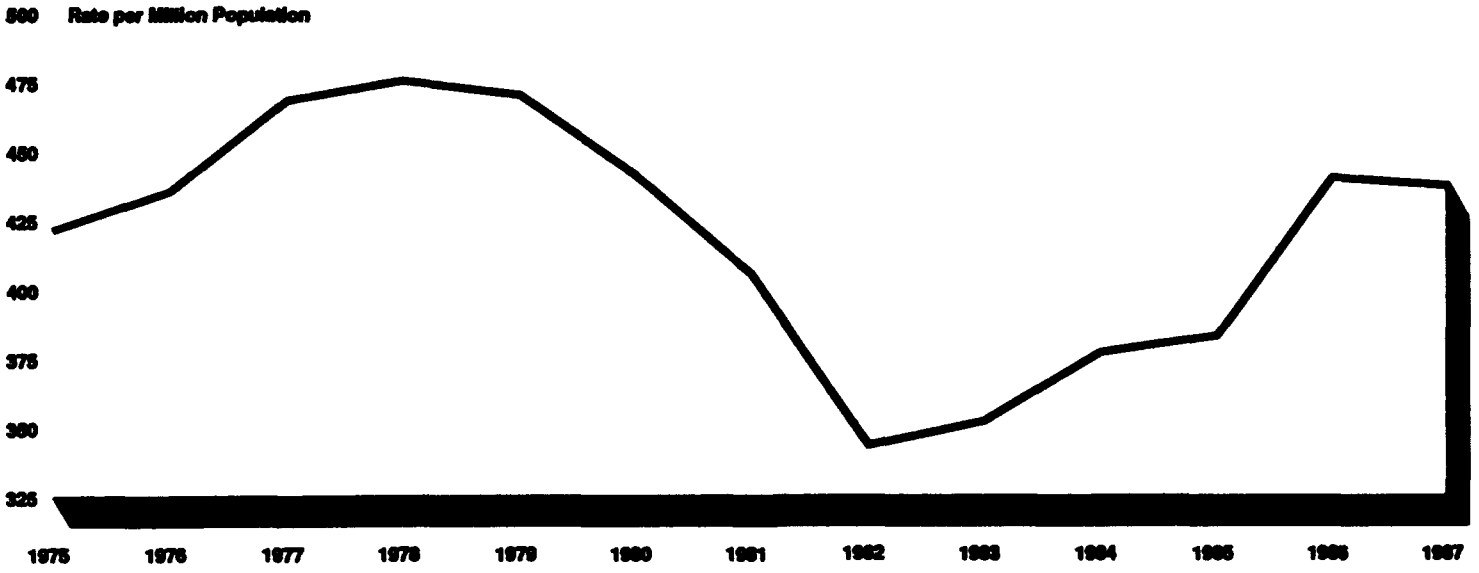
nvolvement Rates by Age

There is a wide divergence in driver involvement in fatal accidents across age groups. In 1987, fatal accidents ranged from fewer than 200 per million population for those older than 65 to a high of generally almost 600 per million for the 18- to 20-year-old age group. The involvement rate generally declines as drivers get older. (See table III.1.) With some variations, trends for all age groups tend to follow the overall trend, the under-16, 16- and 17-year-old, and over-65-year-old drivers being the principal exceptions. The interesting difference about the pattern for 16- and 17-year-olds is the increase in the rate of involvement since 1982. (See figure III.3.) The rate increased from about 340 per million population in that year to about 440 per million in 1987, an increase of over 25 percent. After generally declining from 1975 through 1982, the rate of driver involvement in fatal accidents for those older than 65 increased about 16 percent from 1982 through 1987, 1987 having the highest involvement rate on record. (See figure III.4.)

Table III.1: Driver Involvement in Fatal Accidents Per Million Population in 1987

Age group	Male	Female	Overall
16-17	622	243	437
18-20	922	266	596
21-25	847	218	533
26-50	501	135	317
51-65	319	89	198
Older than 65	300	83	170
Overall	468	127	296

Figure III.3: Fatal Accident Rate for Drivers 16 and 17

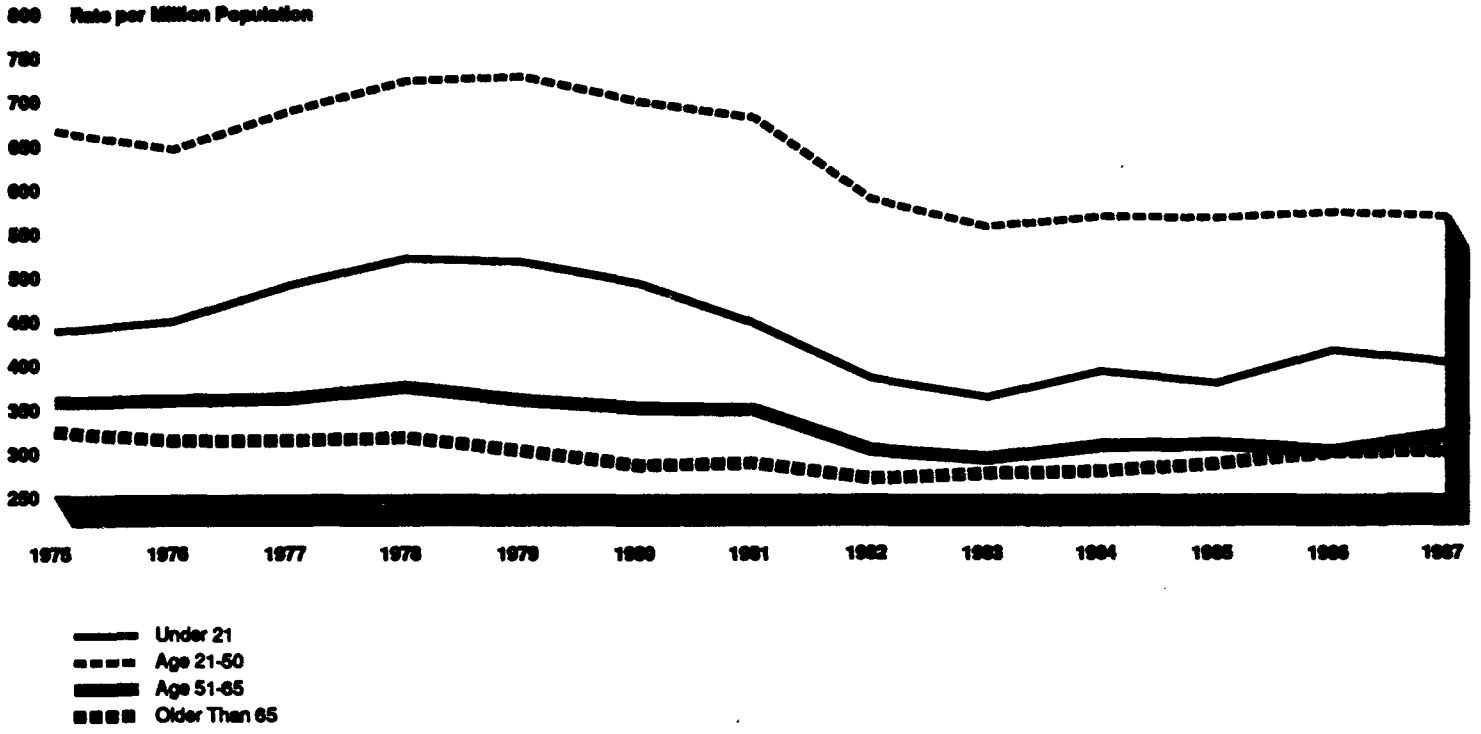


re III.4: Fatal Accident Rate for Drivers Older Than 65

volvement Rates by Age d Gender

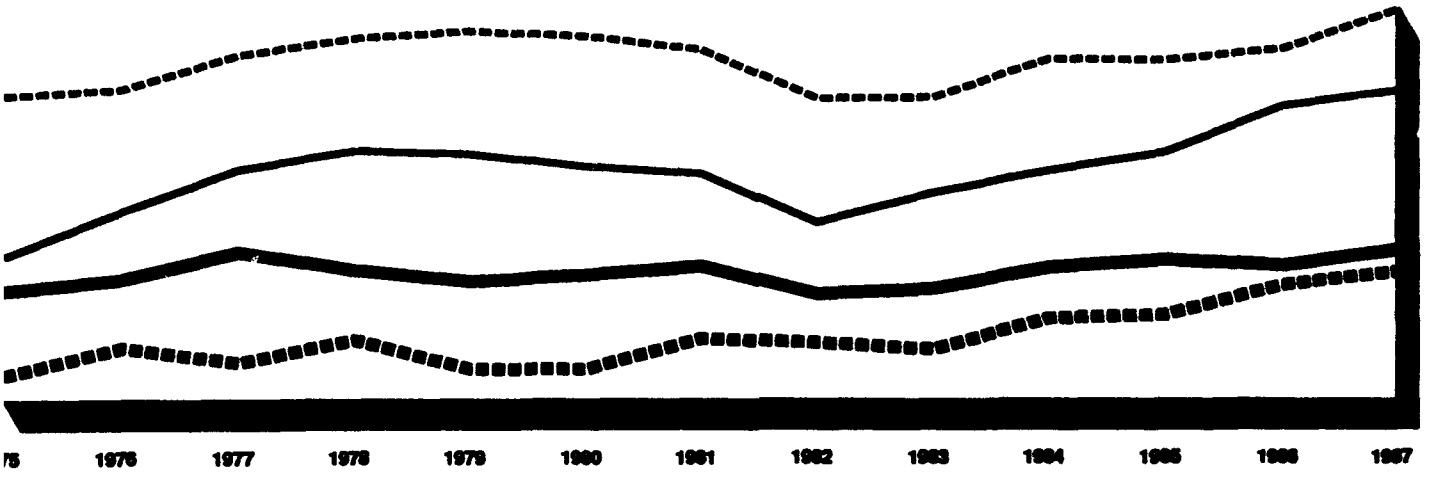
The distribution of fatal accident involvement across age groups is different for male and female drivers. (See figures III.5 and III.6.) The rates for males range from slightly over 300 fatal accidents per million population for those older than 65 to a high of 900 to 1,100 per million for the 18- to 20-year-old age group. Females have the same high and low age groups, but the driver involvement rates are less than 80 per million for the older females and from about 200 to 300 per million for the younger group.

Figure III.5: Male Driver Fatal Accident Rate by Age Group



re III.6: Female Driver Fatal Accident Rate by Age Group

Rate per Million Population



While the fatal accident rate for male drivers of nearly all age groups tends to follow the overall trend, the rate for females has increased rather steadily across all age groups, especially since 1982. The year 1987 showed the highest rate of involvement per million population for all female age groups.

ge and Gender of iver

Male drivers are involved in fatal motor vehicle accidents about four times as often as female drivers. (See table III.2.) However, while the number of male drivers involved in fatal accidents tends to follow the overall trend, the number of female drivers has been increasing since 1975. Nonetheless, the increase for female drivers since 1975 is not spread evenly over all age groups. Moreover, analyzing male drivers by age group shows that the overall trend also is not applicable to all age groups. The number of female drivers under age 16 involved in fatal accidents in 1987 was over 40 percent more than in 1975, while the number of male drivers this age was about 18 percent less than in 1975. In neither case were many drivers involved, however, so this trend exerted little influence on the difference in the overall trend.

Table III.2: Drivers Involved in Fatal Accidents by Age and Gender

Gender	Age group	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Male														
	Under 16	444	449	481	460	460	424	388	332	328	366	384	382	365
	16-17	2,922	2,985	3,222	3,300	3,140	2,902	2,601	2,092	1,967	2,059	2,037	2,422	2,426
	18-20	6,858	6,996	7,580	8,049	7,980	7,595	6,824	5,852	5,348	5,655	5,227	5,456	5,131
	21-25	8,949	9,023	9,940	10,565	10,976	10,764	10,469	9,112	8,429	8,859	8,882	9,051	8,655
	26-50	18,341	18,008	19,566	21,174	21,784	21,531	21,731	19,404	19,175	19,955	20,293	21,218	21,822
	51-65	5,289	5,368	5,456	5,705	5,527	5,428	5,430	4,744	4,622	4,805	4,822	4,697	4,961
	Older than 65	2,728	2,711	2,775	2,872	2,801	2,701	2,783	2,673	2,788	2,880	3,029	3,239	3,336
	Unknown	120	93	105	110	115	118	110	161	155	144	172	188	186
	Total	**45,651**	**45,633**	**49,134**	**52,235**	**52,783**	**51,463**	**50,336**	**44,370**	**42,812**	**44,723**	**44,846**	**46,653**	**46,882**
Female														
	Under 16	74	81	102	102	84	98	93	80	88	80	95	122	105
	16-17	676	732	806	793	851	801	708	578	660	687	753	854	900
	18-20	1,221	1,407	1,534	1,619	1,526	1,467	1,502	1,336	1,358	1,402	1,368	1,431	1,454
	21-25	1,602	1,694	1,920	2,058	2,021	2,028	2,008	1,856	1,886	2,020	2,135	2,137	2,218
	26-50	3,855	3,941	4,226	4,427	4,700	4,792	4,801	4,482	4,605	5,117	5,131	5,420	6,002
	51-65	1,301	1,365	1,501	1,436	1,399	1,438	1,482	1,360	1,383	1,473	1,502	1,472	1,534
	Older than 65	701	814	788	888	809	827	895	967	962	1,107	1,142	1,289	1,373
	Unknown	27	10	15	15	17	15	20	16	16	21	16	19	18
	Total	**9,457**	**10,044**	**10,892**	**11,338**	**11,409**	**11,466**	**11,509**	**10,675**	**10,958**	**11,907**	**12,142**	**12,744**	**13,604**
Unknown		34	20	23	27	39	28	309	984	886	882	895	938	948
Total drivers		**55,142**	**55,697**	**60,049**	**63,600**	**64,231**	**62,957**	**62,154**	**56,029**	**54,656**	**57,512**	**57,883**	**60,335**	**61,434**

For drivers 16 and 17, the number of male drivers again tends to follow the overall trend, while the number of female drivers shows substantial swings in the trend. The involvement of male drivers 16 and 17 years old reached a peak in 1978 but then decreased about 40 percent through 1983. Even though the number of male drivers of this age involved in fatal accidents increased from 1983 through 1987, the number in 1987 was still about 25 percent less than the peak year of 1978. Female drivers in this age group involved in fatal accidents increased about 26 percent from 1975 through 1979 and then fell dramatically by about 32 percent to a low in 1982. From 1982 through 1987, however, female drivers of this age in fatal accidents increased about 56 percent, to reach the peak of 900 in 1987.

While the number of male drivers 18 through 20 followed the overall trend through 1983, this group did not show the increase since 1983 that is characteristic of the overall trend. While there were both

increases and decreases in the number of male drivers in fatal accidents after 1983, the 1987 total was the lowest for the period of our study. The number of female drivers in this age group in fatal accidents tends to follow the overall trend. The number of female drivers involved in fatal accidents in 1987 is almost 20 percent higher than the low of 1975 but about 10 percent lower than the high of 1978.

There are also significant differences between male and female drivers in the 21- through 25-year-old age group. While the involvement of both groups tended to follow the overall trend, the involvement of female drivers increased dramatically after 1982. The involvement of male drivers showed modest increases after 1983, and the total for 1987 was the second lowest number of male drivers in this age group involved in fatal accidents. The number of female drivers for this age group involved in fatal accidents in 1987 was the highest so far, and it was almost 40 percent higher than the low of 1975. The male total for 1987 was about 3 percent lower than 1975 and more than 20 percent below the peak year of 1979.

For both male and female drivers in the 26- through 50-year-old age group, the number involved in fatal accidents in 1987 was the highest on record. However, the number of female drivers in this age group increased over 50 percent since 1975, while the number of male drivers increased only about 20 percent. Moreover, the number of male drivers in this age group involved in fatal accidents decreased in 4 different years, but the number for female drivers decreased only once.

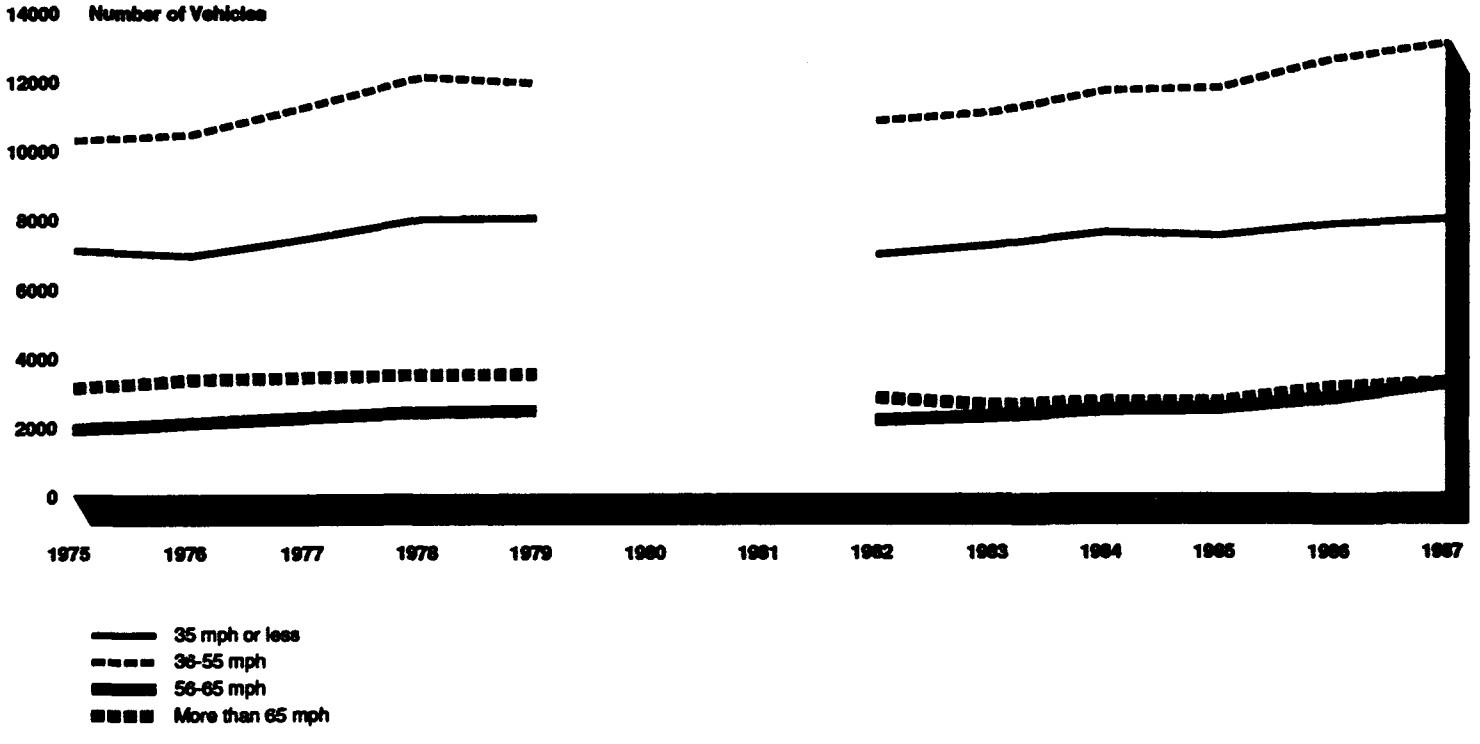
Male and female drivers in the 51- to 65-year-old age group also show differences. Male involvement for this age group has tended to follow the overall trend; female involvement, while erratic, has shown a general tendency to increase since 1975. The number of male drivers of this age involved in fatal accidents has decreased about 6 percent since 1975, while the number of female drivers has increased about 18 percent. Only for the over-65 age group does the involvement of male and female drivers show similar trends, and both are on the increase. The involvement of female drivers in this age group has almost doubled since 1975, while the number of male drivers has increased over 20 percent.

Speed of Vehicles

The speed of vehicles involved in fatal traffic accidents is a measure of driver behavior. Unfortunately, speed is also difficult to measure, and for all years of our analysis, the speed of about 55 to 60 percent of the

vehicles involved in fatal accidents was reported as unknown. Nevertheless, the analysis of known speeds yields some interesting insights. For vehicles for which speed is known, the 36 to 55 miles per hour range is the most frequent speed encountered. (See figure III.7.) Further breakdown of this speed bracket shows that vehicles with speeds of 46-55 mph account for about 60 percent of the vehicles in this bracket. These breakdowns also show that vehicles with speeds of less than 55 mph are more involved in fatal accidents than vehicles with higher speeds. However, since data on speed are available for only about 40 to 45 percent of the vehicles in fatal accidents, the issue of the relationship of speed to fatal accidents still needs to be investigated further.

Figure III.7: Speed of Vehicles in Fatal Accidents[a]



[a]Data on speed are unavailable for 1980 and 1981.

Drinking Drivers

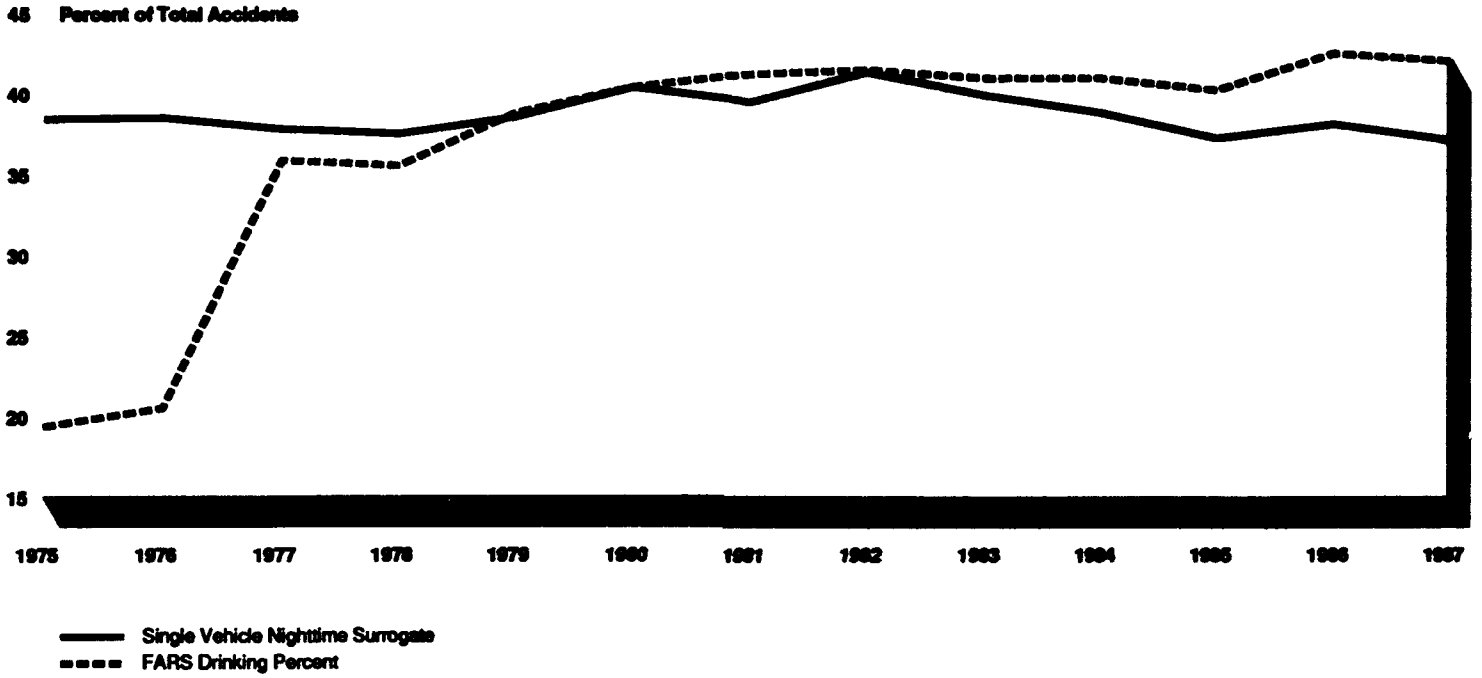
The presence of drinking drivers has been a matter of concern in highway safety for many years. Unfortunately, not all states have been diligent in determining whether drivers in fatal accidents had been

drinking, so the FARS data are not as useful as one would like. Data reporting on drinking drivers is improving, however, and NHTSA has recently used analytical techniques to obtain measures that offset inadequate reporting.[2] Nevertheless, some insights into drinking as a factor in fatal accidents are available.

Since 1977, more than 35 percent of the fatal accidents reported involved the presence of at least one drinking driver. (See figure III.8.) Between 2 and 3 percent of those accidents involved two or more drinking drivers. The number of fatal accidents involving drinking drivers—whether one or two or more such drivers—tends to follow the overall trend, especially since 1977. In our opinion, 1975 and 1976 reflect data collection problems more than a better drinking-driver record for those years. Because of the reporting problems connected with drinking drivers, we determined the trend in the number of fatalities related to single-vehicle nighttime accidents, a common surrogate measure for drinking drivers. This analysis shows that the rates were not very different. Therefore, we believe the reported number of drinking drivers may be more accurate than is generally believed.

[2]These techniques use the experience of states that have good reporting on drinking drivers to impute drinking experience for reported missing values in all other states.

Figure III.8: Drinking Drivers Reported in FARS Compared to Single-Vehicle Nighttime Accidents[a]



[a]For this analysis, night time is 6:00 p.m. to 6:00 a.m.

The Use of Safety Restraints

Perhaps the most interesting insight about the use of safety restraints is the relatively small, though increasing, percentage of drivers and passengers in fatal accidents who use them and the increasing ability of accident investigators to determine whether they were used, as evidenced by the continuing decline in the percentage of both drivers and passengers whose use of them was labeled unknown. (See figures III.9 and III.10.) Since both the percentage not using safety restraints and the percentage whose usage is unknown have been declining at the same time in recent years, the increasing percentages shown for the use of safety restraints since 1981 are, indeed, real increases.

Figure III.9: Motor Vehicle Occupants in Fatal Accidents Reported Using Safety Restraints

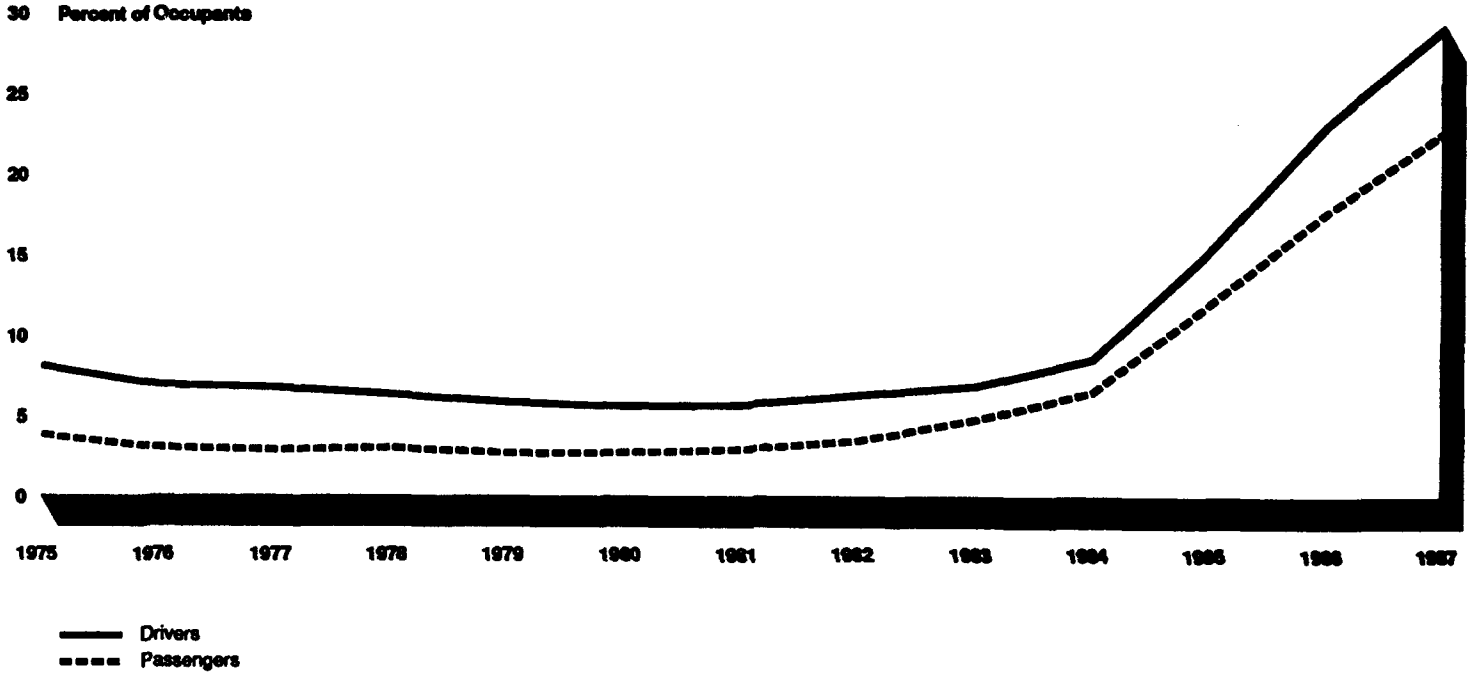
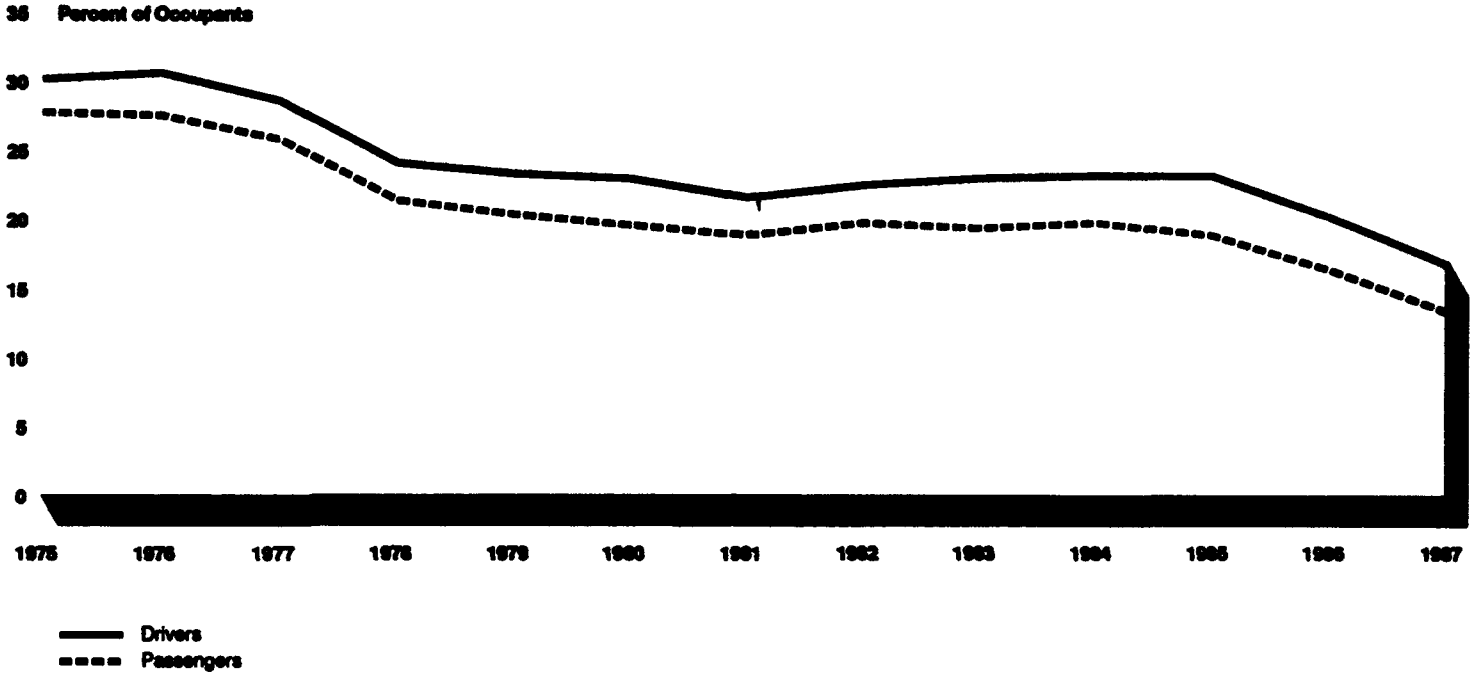
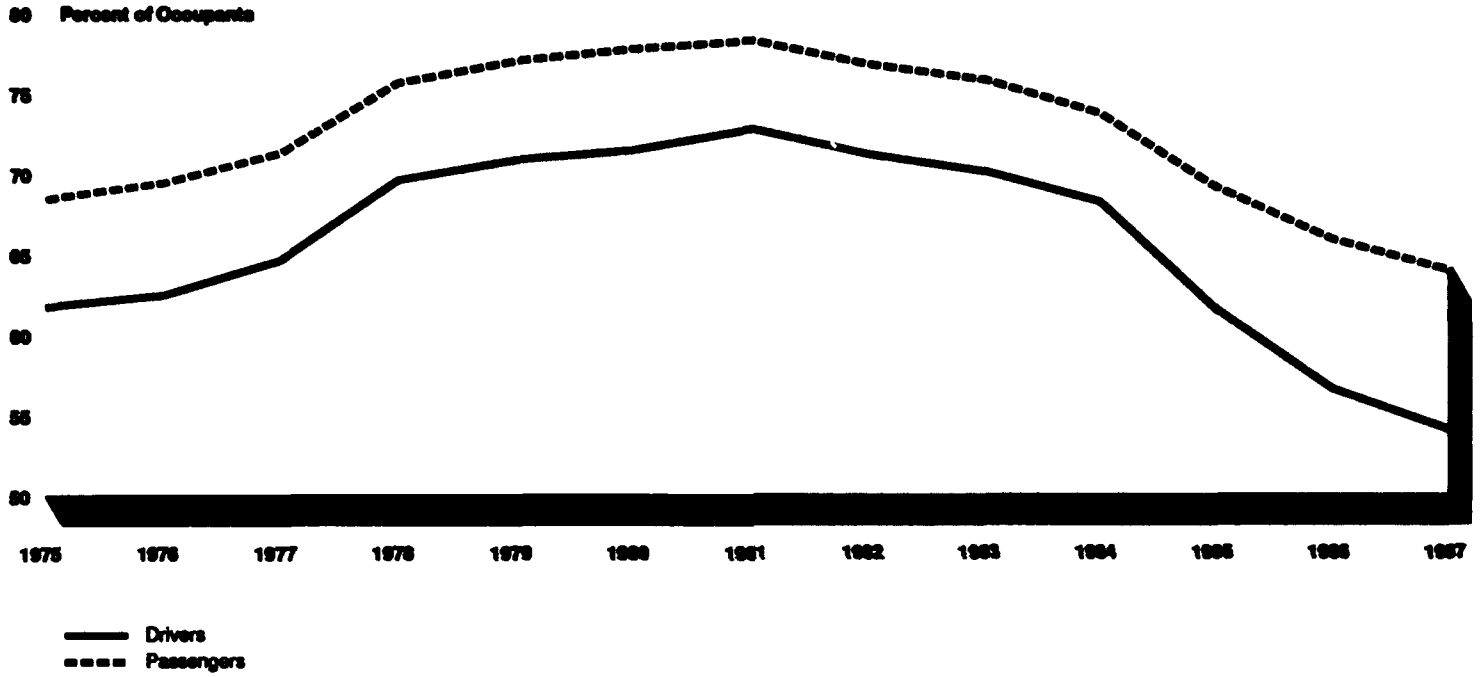


Figure III.10: Motor Vehicle Occupants in Fatal Accidents Whose Reported Use of Restraints Is Unknown



For both drivers and passengers, the percentage reported not using safety restraints continued to rise from 1975 until 1981, but both have been on the decline since then. (See figure III.11.) Nonuse by drivers reached a high of about 73 percent in 1981 and fell after that to about 54 percent in 1987. Nonuse by passengers fell from about 78 percent to about 64 percent in the same period. The reported use of safety restraints increased from about 6 to about 30 percent over this period, while the reported use for passengers increased from about 3 to about 23 percent. Over this same period, the percentage whose use was unknown fell from about 22 to about 17 for drivers and from about 19 to about 13 for passengers. The experience of recent years, therefore, shows either an increased interest by the driving public in protecting themselves in motor vehicle accidents or the effectiveness of recently enacted mandatory seat belt laws, or perhaps both.

Figure III.11: Motor Vehicle Occupants in Fatal Accidents Reported Not Using Safety Restraints



Has the greater use of safety restraints been reflected in fatality patterns? Comparing fatality data to use patterns shows that, while the percentage of drivers not using safety restraints who are killed has been steadily increasing, the percentage of drivers who used restraints and were killed anyway has been steadily declining. (See figures III.12-III.14.) Moreover, while the percentage of passengers not using safety restraints who are killed has tended to follow the overall trend, the percentage of drivers who used restraints and were killed has also been steadily declining. Since the percentage of both drivers and passengers killed whose safety restraint usage is unknown has also been declining, a case can be made that many whose restraint usage is unknown probably are using them.

Figure III.12: Occupants Killed Who Were Not Using Safety Restraints

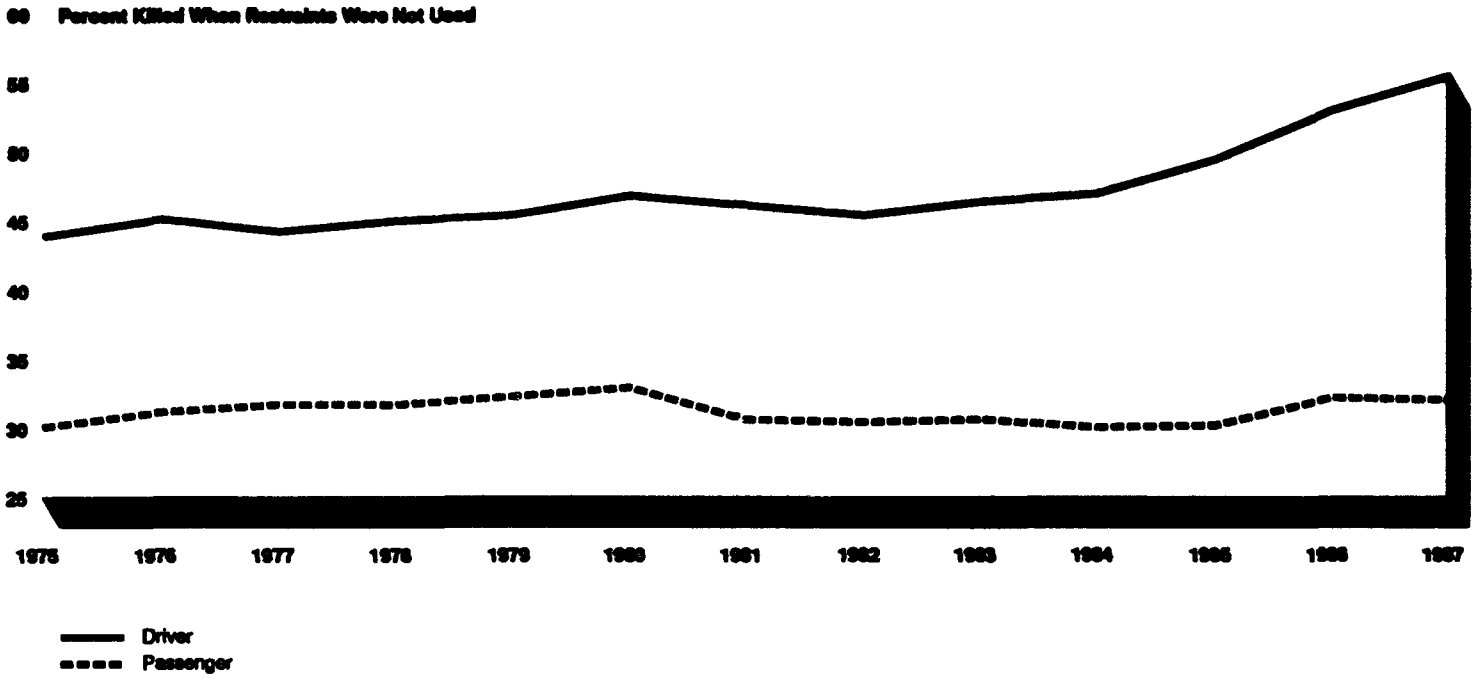


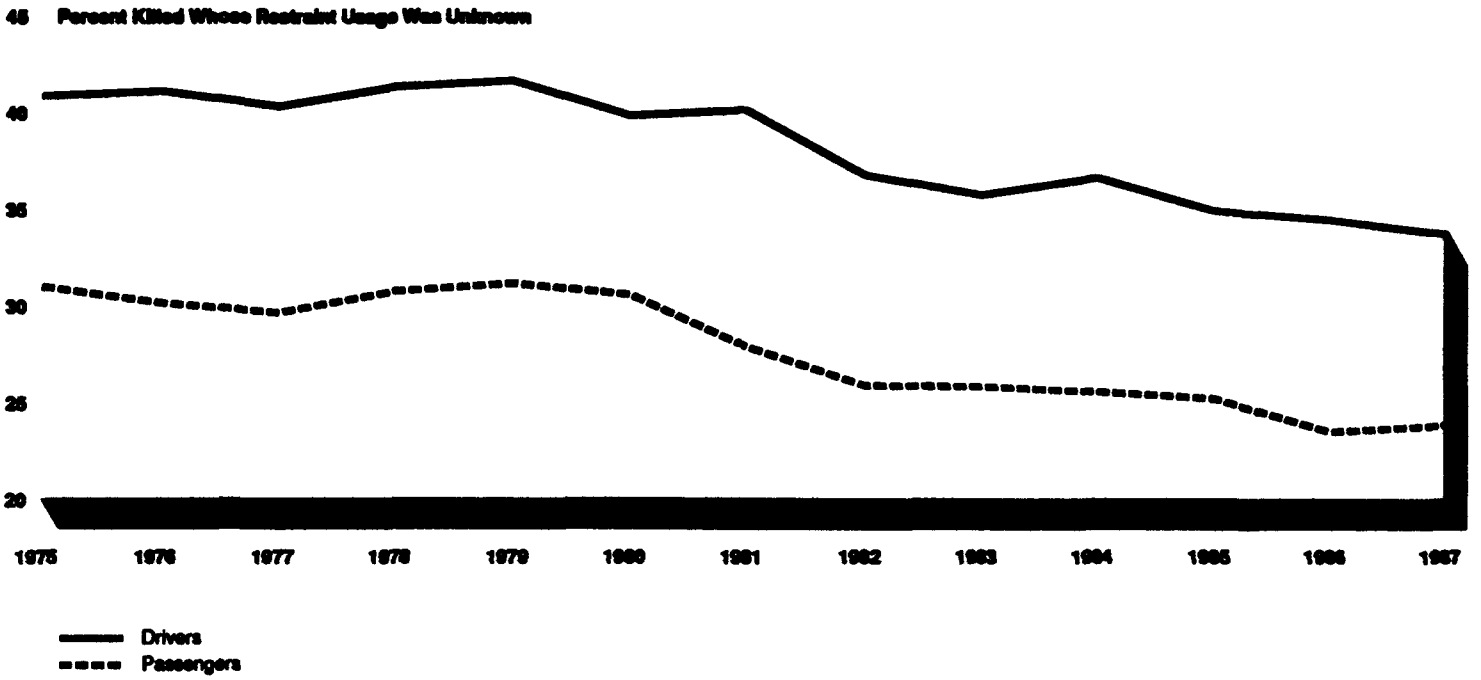
Figure III.13: Occupants Killed Who Were Using Safety Restraints

Conclusions

The overall trend—increases through 1980, decreases through 1983, and then increases through 1987—applies not to all but to many driver-related statistics. Drivers clearly are the greater part of motor vehicle fatalities, and male drivers dominate in involvement in fatal accidents, whether viewed in simple numbers or as rates of involvement in fatal accidents. However, more females are becoming involved in fatal accidents.

Drinking drivers are still a very serious traffic safety problem, but FARS data do not disclose any trends that diverge much from the overall trend. Our analysis of the number of fatalities related to single-vehicle nighttime accidents, a common surrogate measure for drinking drivers, shows that the reported number of drinking drivers may be more accurate than is generally believed.

Figure III.14: Occupants Killed Whose Use of Restraints Was Unknown



Increased use of motor vehicle safety restraints since 1979 or 1980 appears to have saved the lives of many motor vehicle drivers and passengers. More and more occupants are reported using safety restraints. Moreover, the fatality trend for occupants who are reported as using restraints has been steadily declining while the trend for those reported as not using restraints has been steadily increasing. While high driving speeds are likely to be a problem, FARS data are so limited that they are of little help in firmly establishing trends related to speed.

Vehicle-Related Statistics

In this appendix, we address several issues related to motor vehicles, including accident involvement rates and fatality rates by type of vehicle, the effects of the changing combination of vehicle sizes and the aging of vehicles, and how fatalities depend on the type of collision. The discussion on involvement rates and fatality rates is limited to automobiles and trucks, since registration information is not readily available for other types of vehicles.

Fatal Accident Involvement Rates by Type and Size of Vehicle

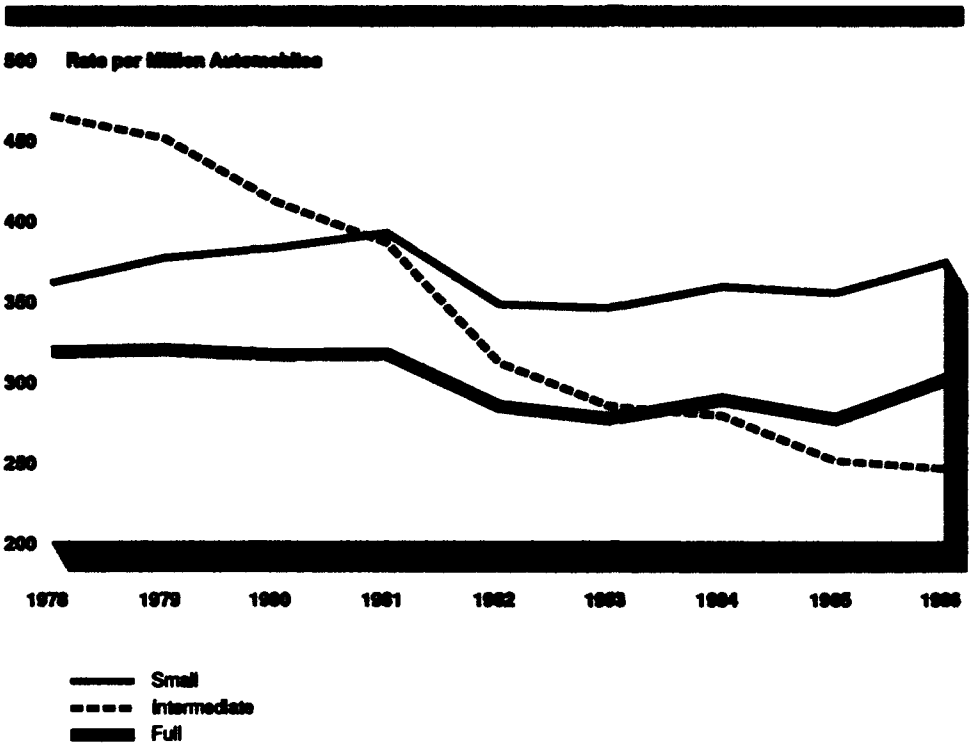
The number of full-size automobiles in fatal accidents declined at the same time that there were significant increases in the number of small and intermediate cars involved in fatal accidents. The question arises, therefore, as to whether this indicates inherent safety differences by size of automobile or whether the accident numbers simply reflect the changing composition of vehicle types the public drives. Relating the numbers of accidents to the number of registered vehicles helps answer this question.[1] In some cases, the trends in involvement rates and fatality rates are generally the same as the absolute numbers (for example, full-size automobiles), whereas in others the rates show a trend completely the reverse of the absolute numbers (for example, small and intermediate automobiles).

Automobiles

The increases noted in the number of small and intermediate automobiles involved in fatal accidents are not apparent when the increase in the number of these automobiles on the roads is taken into account. (See figure IV.1.) It is also interesting that while the accident involvement rate for intermediate automobiles was the highest by far in 1978, it has declined so rapidly—almost a 50-percent decline since 1978—that by 1986 the rate for these cars was the lowest. This figure also clearly shows that the fatal accident involvement rate for small automobiles is now higher than for either intermediate or full-size cars. The fatal accident involvement rate for full-size automobiles was the lowest in most years but did not show the same continued decline as the number of such automobiles. As a consequence, full-size automobiles no longer have the lowest fatality rate.

[1] For this analysis, we obtained information from NHTSA that accounts for automobile and truck registrations. For automobiles, we used the same wheel-base measurements as the FARS accident data discussed in appendix II. Inventory data by size were available only for 1978 through 1986. Automobile data were available on computerized files, but these files did not provide information adequate to classify truck data. We did analyses by hand to obtain truck breakdowns and, therefore, limited our review of truck involvement rates to 1980 through 1986.

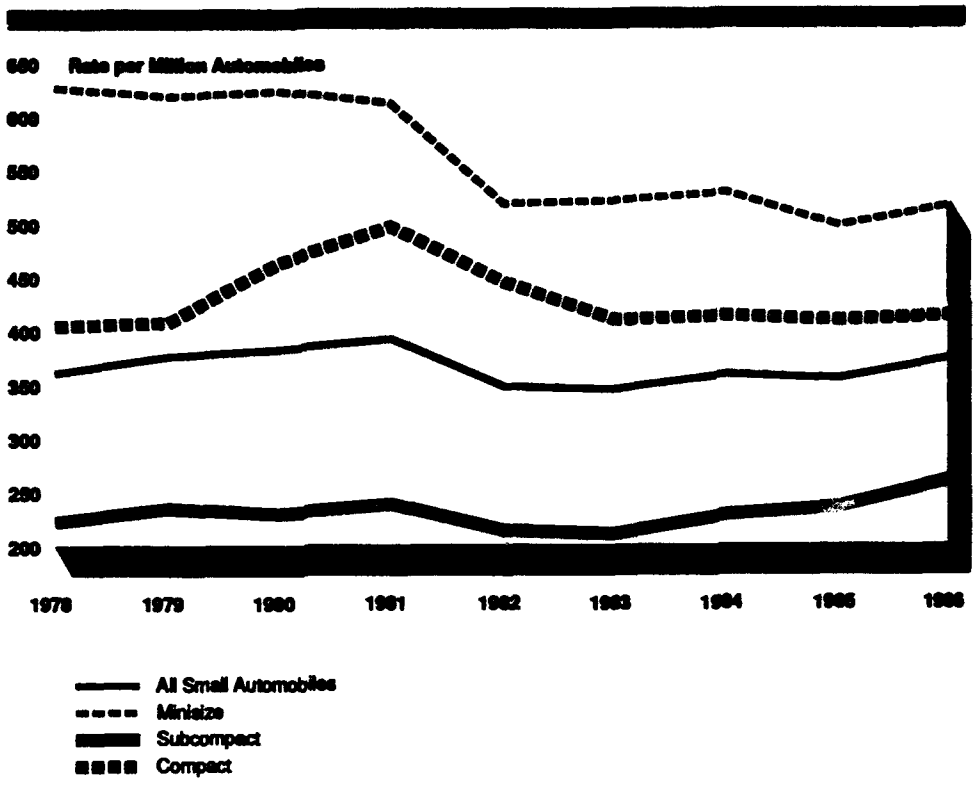
Figure IV.1: Fatal Accident Rate by Size of Automobile[a]



[a]The number of registered automobiles by size was not available for years prior to 1978.

The involvement rate for small automobiles is also not as clear as figure IV.1 might indicate. Disaggregating the total shows not only differing trends for the different sizes of small automobiles but also very different fatal accident involvement rates. (See figure IV.2.) Even though it is on the decline, the involvement rate for minisize automobiles is still the highest by far. Interestingly, the rate for compact automobiles has consistently been higher than that for subcompacts. However, the rate for subcompacts has increased substantially since 1983. The rate for compact automobiles, however, after increasing in the early years, declined rapidly after 1981 and has been rather steady since 1983.

ure IV.2: Fatal Accident Rate for Small
omobiles[a]

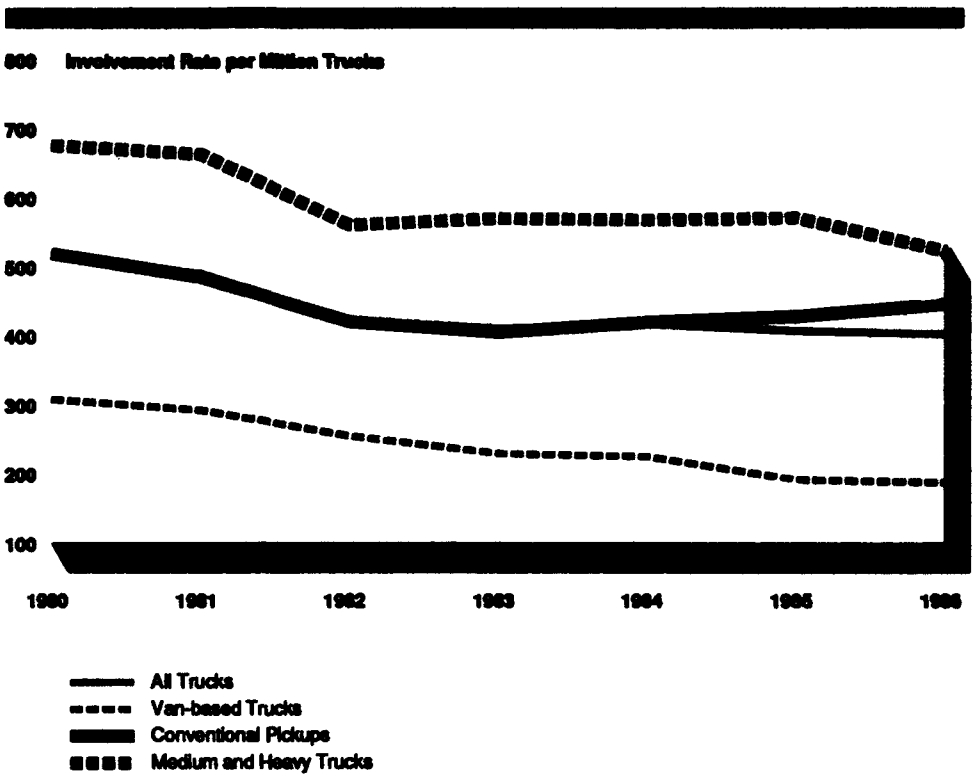


[a]The number of registered automobiles by size was not available for years prior to 1978.

ucks

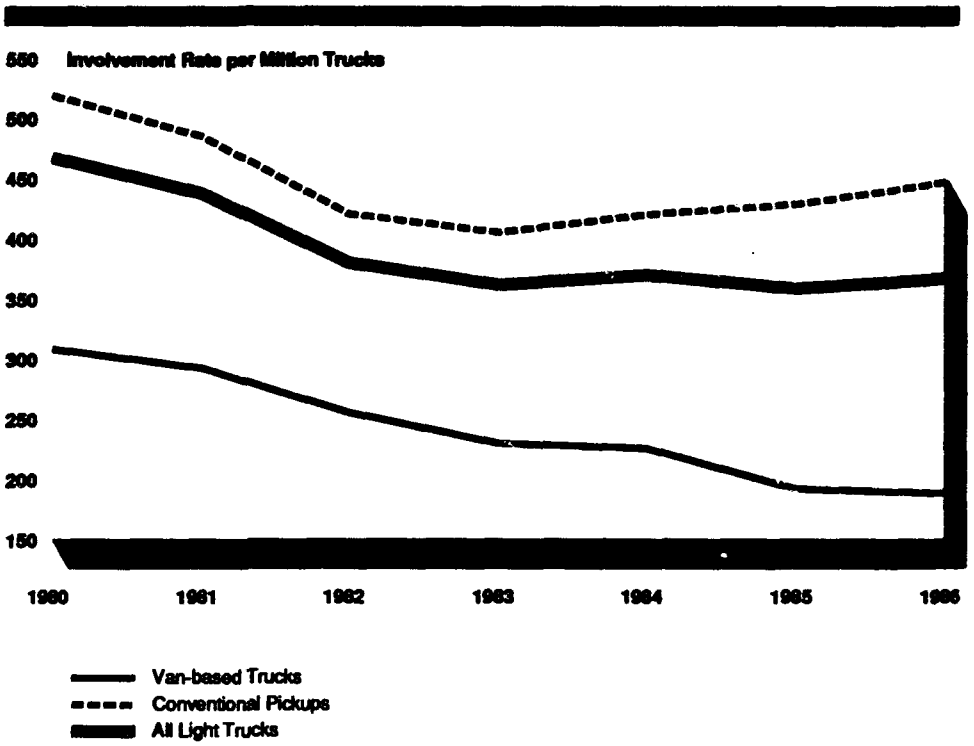
Fatal motor vehicle accident involvement rates for trucks show interesting patterns. (See figure IV.3.) The trucks with the highest involvement rate in fatal motor vehicle accidents are medium and heavy trucks. Van-based light trucks have the lowest involvement rate. Overall truck involvement in fatal accidents has been steadily declining since 1980, only 1 year showing an increase in the rate of involvement. While the involvement of light trucks overall is also declining, the involvement of conventional pickups has been increasing since 1983. (See figure IV.4 on page 68.) The involvement rate for conventional pickup trucks is substantially higher than that for van-based light trucks, and conventional pickup trucks exert the greatest influence on the overall involvement rate for light trucks. While the involvement rate for medium and heavy trucks is the highest of all truck sizes, this rate also has declined since 1980. (See figure IV.5 on page 69.) However, the bulk of this decline occurred in only 1 year; otherwise, the involvement has been rather constant, especially from 1982 through 1985.

Figure IV.3: Fatal Accident Rate by Type of Truck[a]



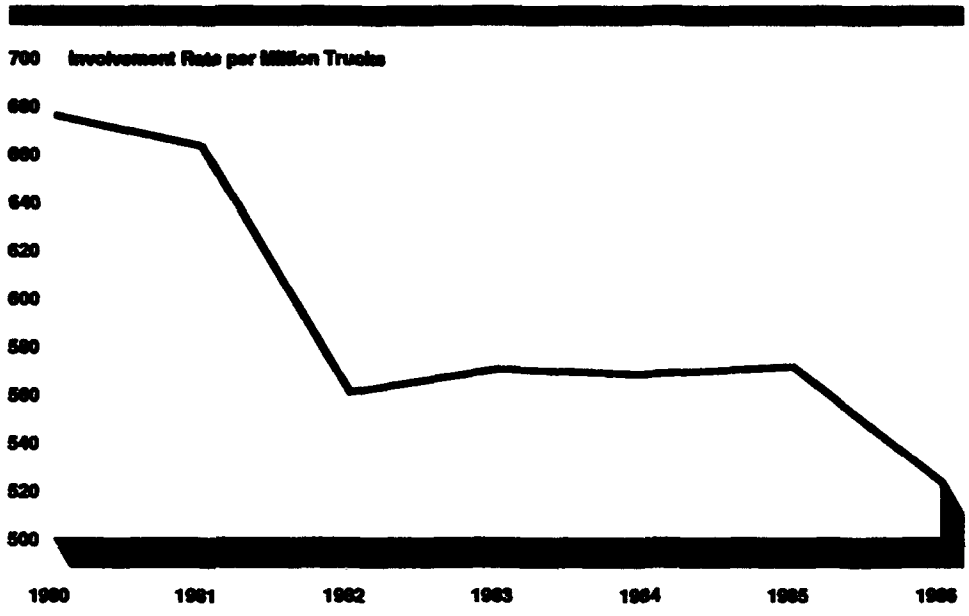
[a]The number of registered trucks by size was not available for years prior to 1979.

Figure IV.4: Fatal Accident Rate by Type of Light Truck[a]



[a]The number of registered trucks by type was not available for years prior to 1979.

Figure IV.5: Fatal Accident Rate for Medium and Heavy Trucks[a]



[a]The number of registered trucks by type was not availabe for years prior to 1979.

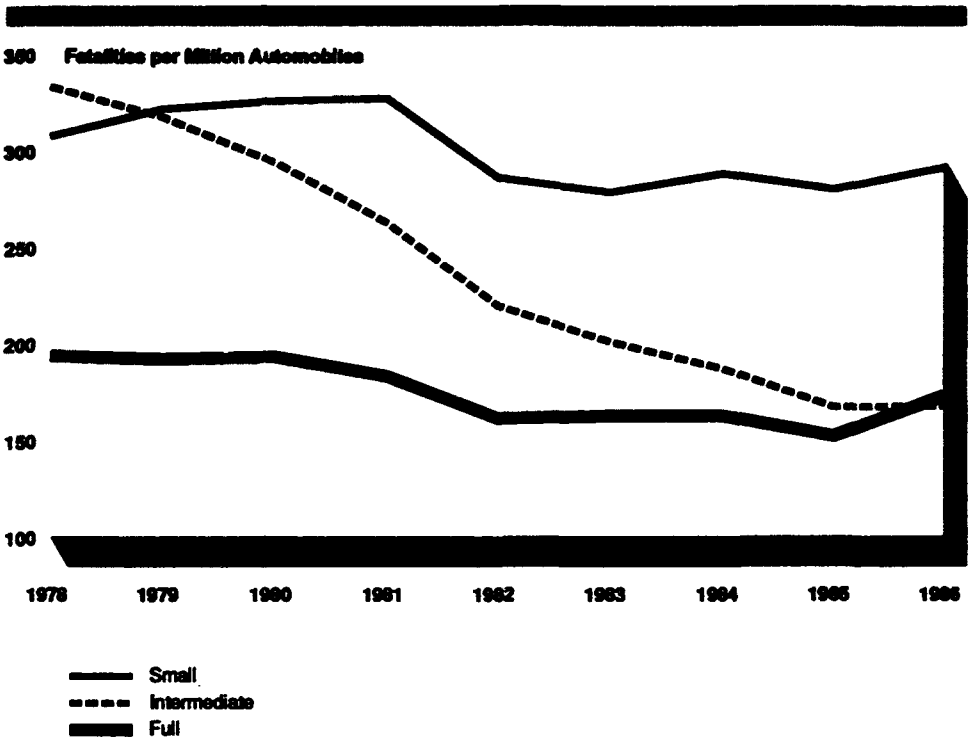
Fatality Rate by Type and Size of Vehicle

We also analyzed fatal motor vehicle accidents to find the differences, if any, in the rates of fatalities by type or size of vehicle and in the trends for these fatalities.

Automobiles

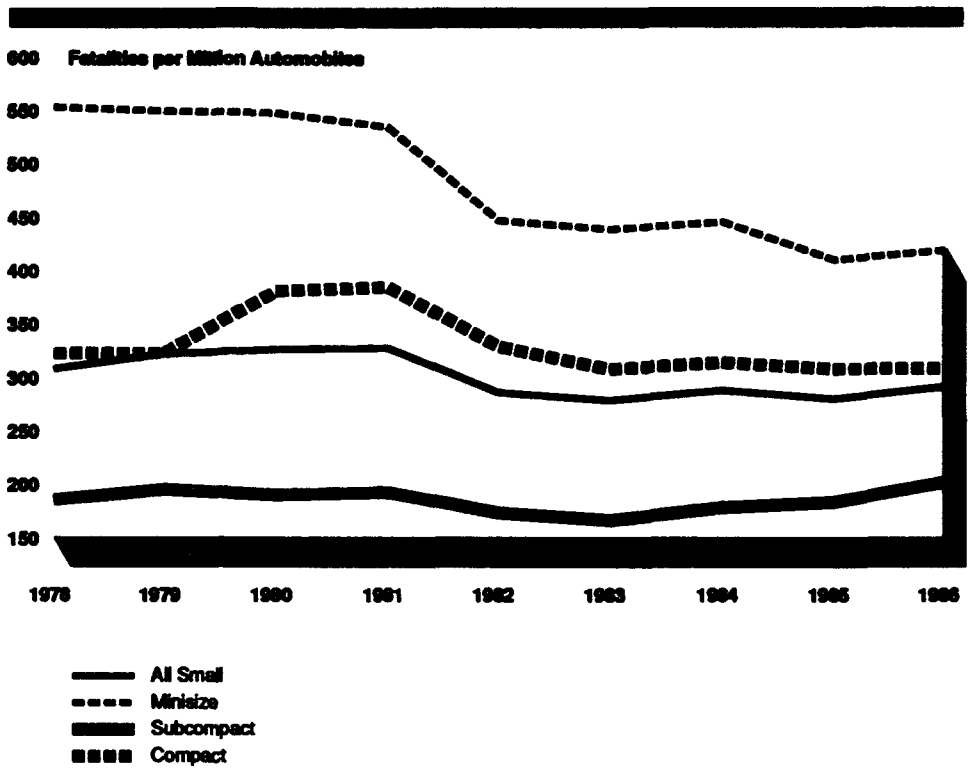
Generally, the relationships for automobile occupant fatalities are similar to the fatal accident involvement rates. (See figure IV.6.) In 1975, the fatality rate for intermediate automobiles was the highest of all automobiles, but by 1986 it was the lowest. The rate for small automobiles has been consistently high, while the rate for full-size automobiles was the lowest in all years except 1986. The rate for full-size automobiles had been declining but in 1986 it increased almost 14 percent. The fatality rate for the occupants of intermediate automobiles has been steadily declining, having decreased about 50 percent from 1978 through 1986. The fatality rate for minisize automobiles was higher than the rate for other small cars, the rate for subcompact cars being the lowest. (See figure IV.7.) The fatality rates for the various types of small automobiles show the same trends as the fatal accident involvement rates for those automobiles.

Figure IV.6: Fatality Rates by Size of Automobile[a]



[a]The number of registered automobiles was not available by size for years prior to 1978.

Figure IV.7: Fatality Rates for Small Automobiles[a]



[a]The number of registered automobiles was not available by size for years prior to 1978.

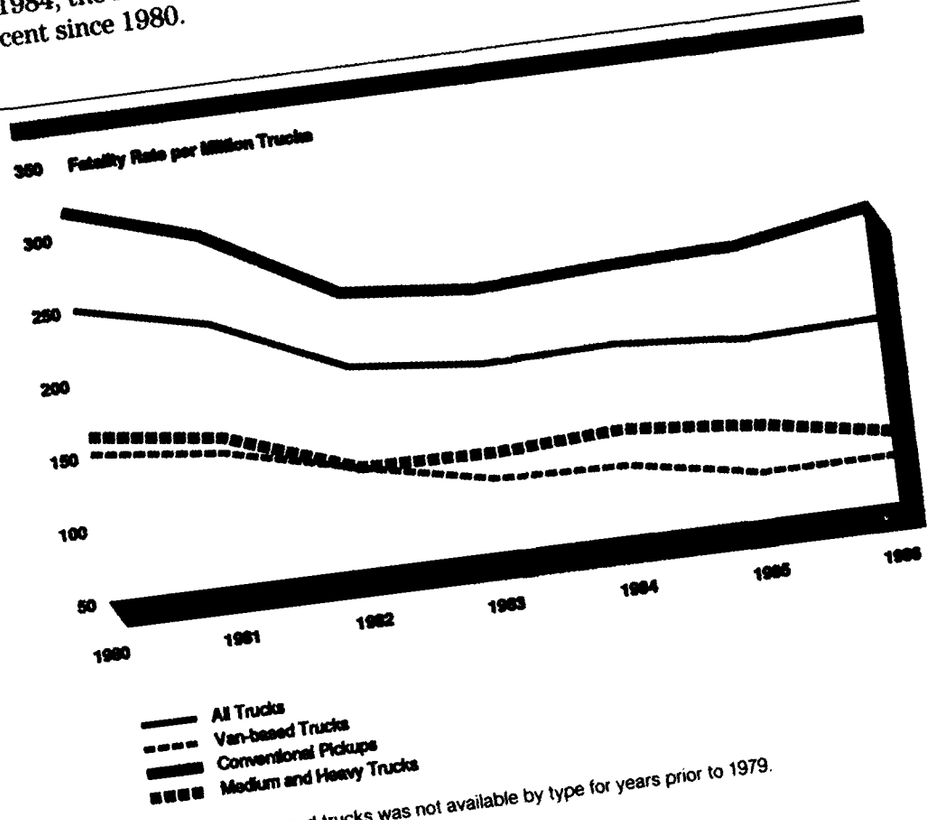
Trucks

Analysis of fatality rates for truck occupants shows how important conventional pickup trucks are in the overall fatality rate for trucks. (See figure IV.8.)[2] The fatality rate for conventional pickup trucks tends to raise the overall truck rate as well as the rate for all light trucks. The rates for van-based light trucks and medium and heavy trucks are small by comparison. The fatality rate for all truck occupants irrespective of size or type of truck has been declining rather steadily since 1978; it has declined over 30 percent since that year. (See figure IV.9.) The number of conventional pickup trucks has exerted a substantial influence on the light truck fatality rate and has shown a general pattern of increase since 1983. While the fatality rate for occupants of van-based light trucks has declined steadily since 1980, decreasing about 45 percent, the rate for occupants of conventional pickups declined only through

[2]As previously indicated, truck fatality rates by size of truck were calculated only for 1980 through 1986. The overall fatality rate for all trucks is available for 1975 through 1986. We classified trucks as light trucks and vans or medium and heavy trucks; we used the coding for body type variable in the FARS data system. These definitions differ from NHTSA definitions of light trucks and vans, which include seven categories of light trucks and vans instead of our two.

1983—a decline of over 25 percent—and then increased about 10 percent from 1983 through 1986. (See figure IV.10.) Although the fatality rate for occupants of medium and heavy trucks did increase slightly in 1984, the rate's overall trend declines, having declined almost 40 percent since 1980.

Figure IV.8: Truck Fatality Rates by Type of Truck[a]



[a]The number of registered trucks was not available by type for years prior to 1979.

Figure IV.9: Overall Truck Fatality Rate

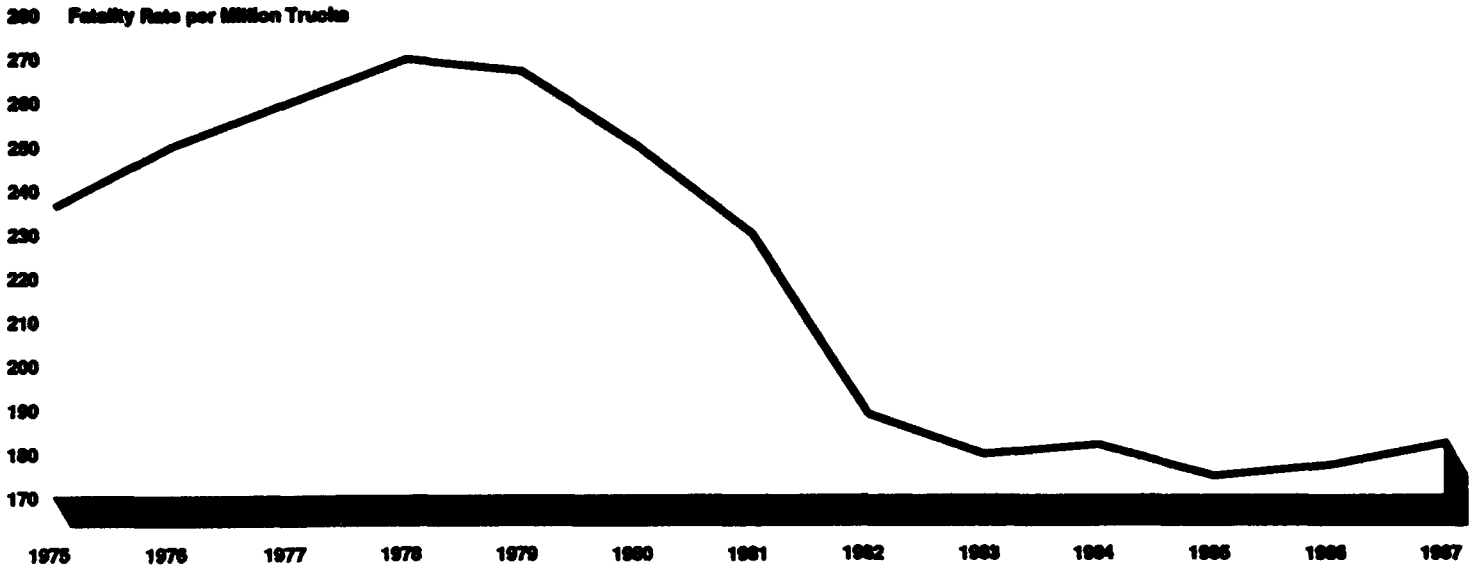
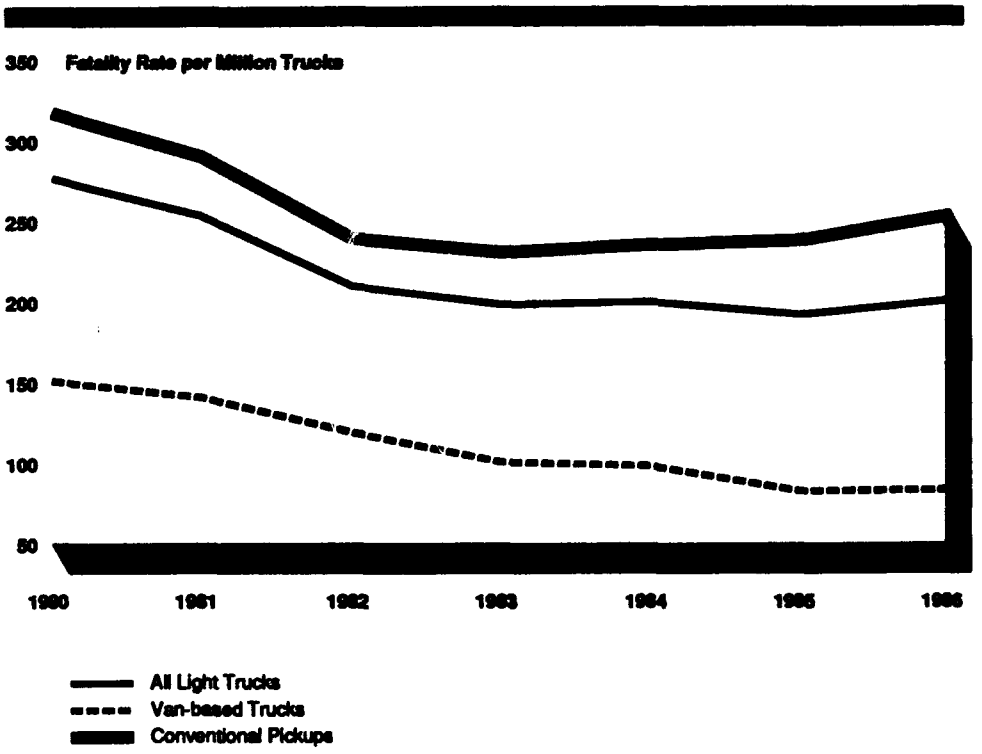


Figure IV.10: Fatality Rates for Light Trucks



The Age of Vehicles Involved in Fatal Accidents

The age of vehicles has always been a matter of concern because older vehicles tend not to be as well maintained as newer vehicles. Moreover, older vehicles do not have all the safety devices mandated by changes in motor vehicle safety standards over the years. Since data on age for vehicles on the nation's highways were readily available only for automobiles and trucks, we have restricted this analysis to these types of vehicles.

The average age of both automobiles and trucks has been steadily increasing since 1975, although it has leveled off in recent years. During this time, the average age of trucks has been consistently older than that of automobiles. However, the average age of automobiles involved in fatal motor vehicle accidents tends to be older than the average age of trucks in such accidents. For automobiles, the average ages of vehicles on the road and of the vehicles involved in fatal accidents are almost the same, but since 1983 there has been a slight divergence. (See figure IV.11.) The same pattern is not prevalent for trucks; the average age has been consistently older than the average age of trucks involved in accidents. (See figure IV.12.)

Figure IV.11: The Average Age of All Automobiles and of Those in Fatal Accidents

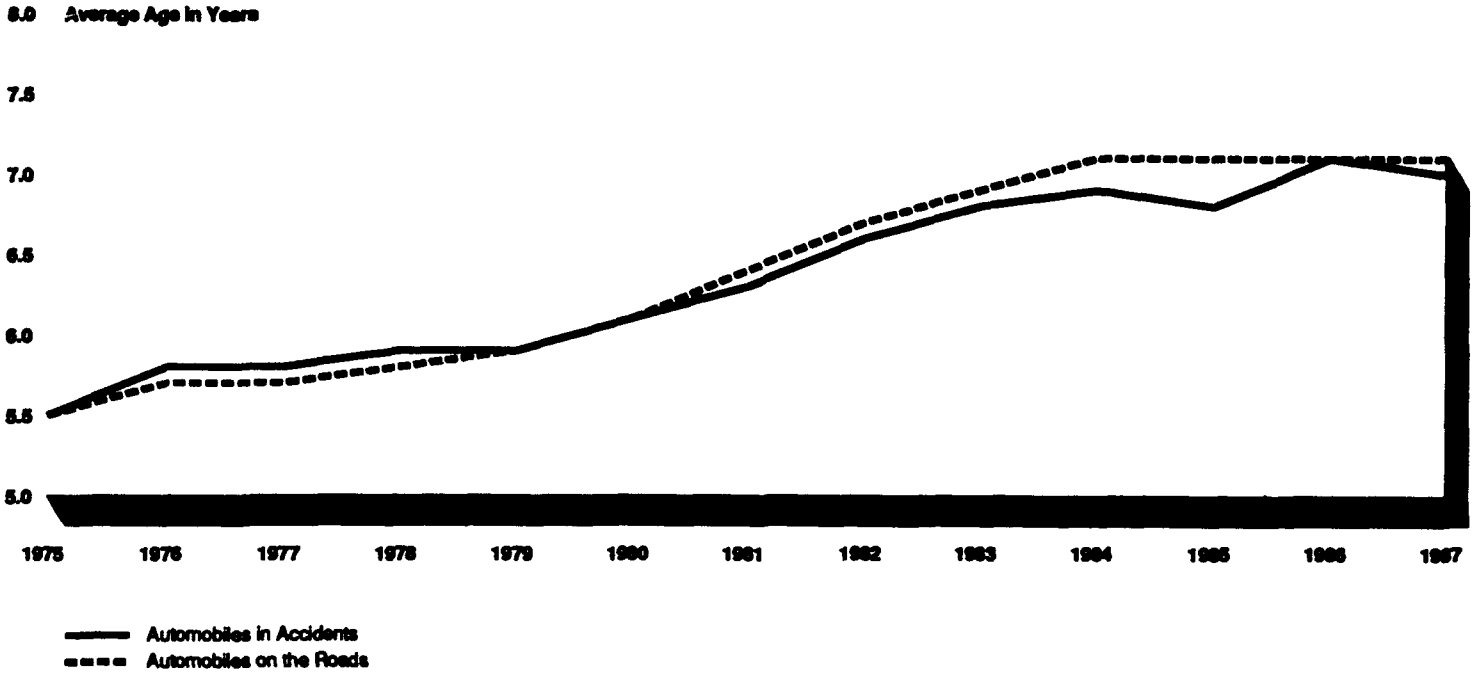
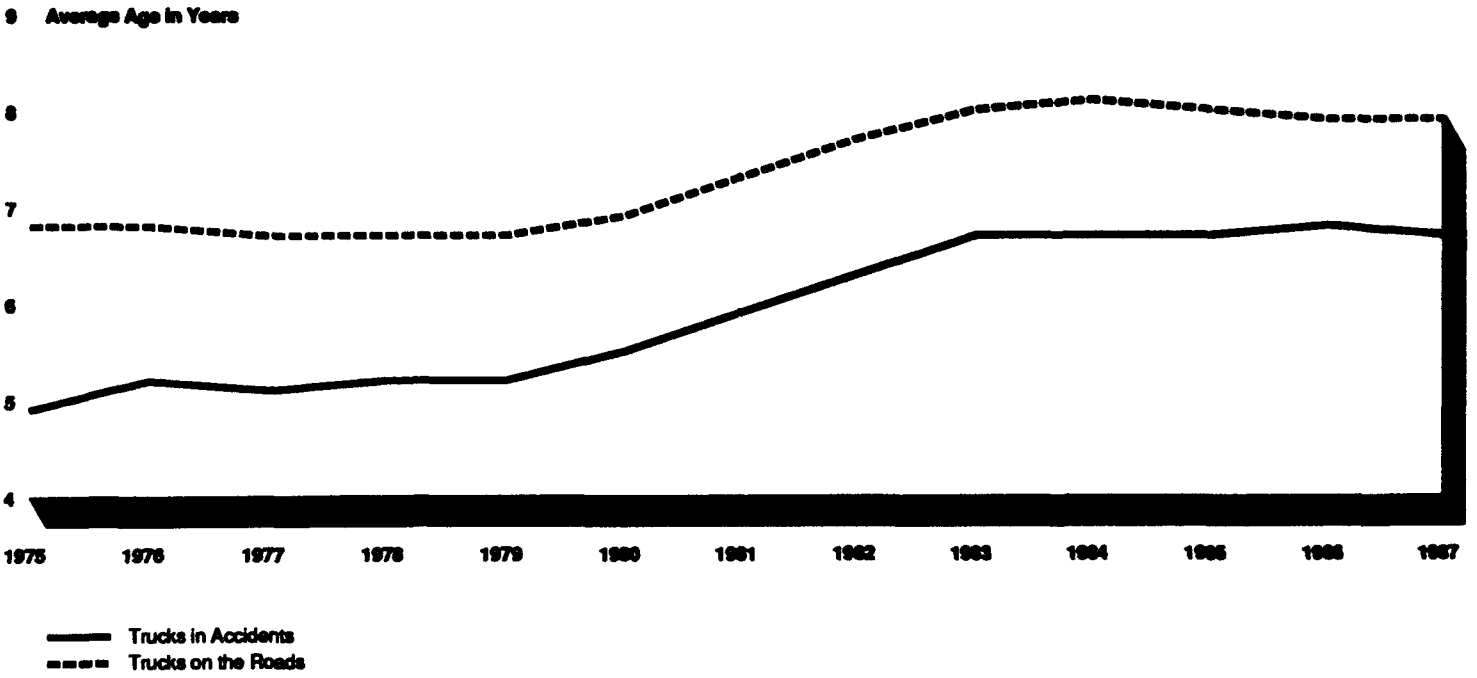


Figure IV.12: The Average Age of Trucks and Those in Fatal Accidents



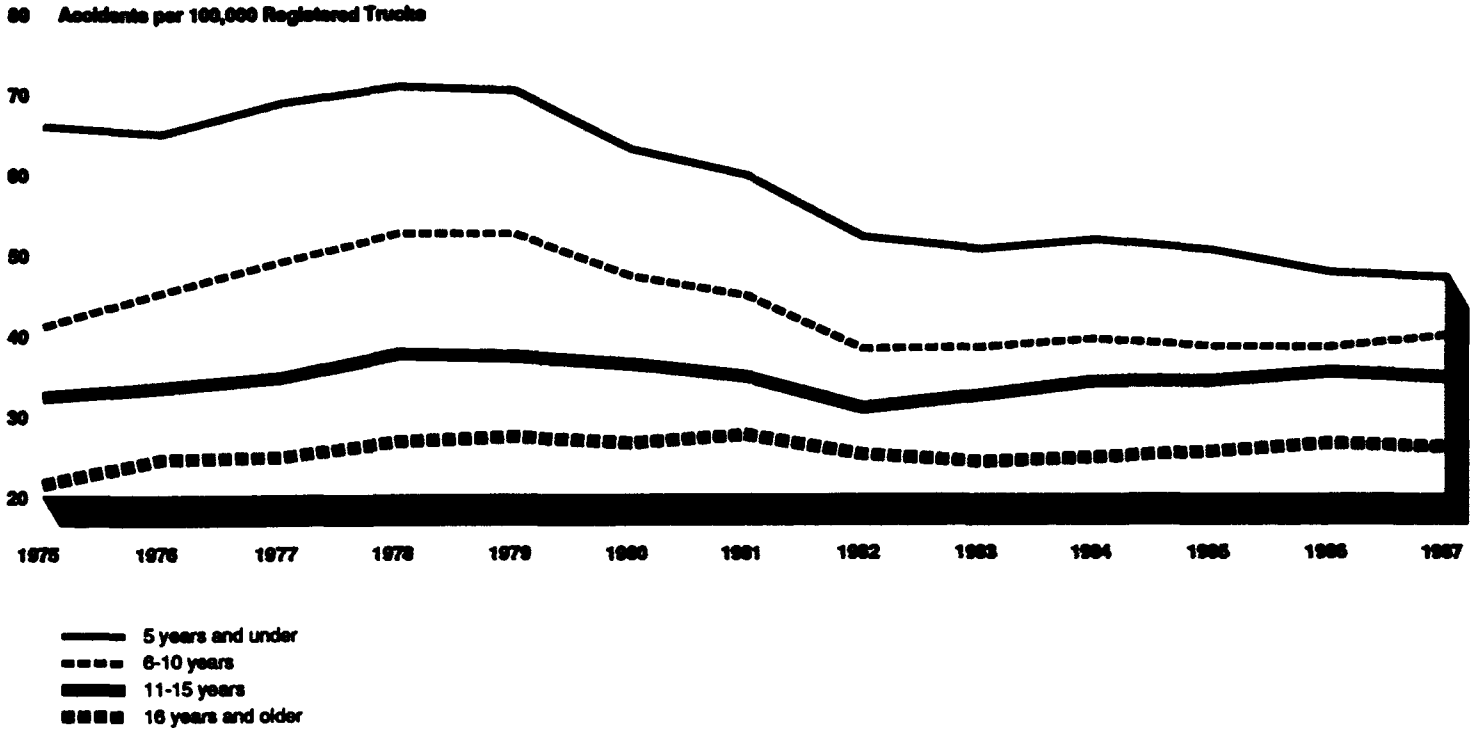
Another difference between automobiles and trucks is that the accident rates per 100,000 registered vehicles for various age groupings of automobiles have tended to converge over the years toward a similar accident rate while the rates for trucks have tended to maintain differing rates for different ages. (See figures IV.13 and V.14.) Moreover, trucks less than 5 years old are more involved in fatal accidents than any other age group for trucks while automobiles 11 to 15 years old tend to have the highest involvement rate. In both instances, however, the rate of involvement has been steadily declining since 1978.

Some of the trend directions for vehicles of various age can be seen when we analyze each age group of vehicles separately. The accident rates per 100,000 registered vehicles for automobiles 15 years old and less have been generally declining since about 1978 and the involvement rates for automobiles 5 years old and less, 6 to 10 years old, and 11 to 15 years old were all between 30 and 33 per 100,000 registered automobiles in 1987. The rate per 100,000 registered automobiles more than 15 years old was about 27 in 1987, close to the rate for automobiles of other ages. The fatal-accident-involvement rates for trucks are different from those of automobiles. Similar to automobiles, the rate for trucks 10 years old

and less has been steadily declining since 1978. However, while trucks 11 to 15 years old underwent a similar decline in the rate from 1978 through 1982, the rate increased significantly from 1982 to 1987.

Figure IV.13: Automobiles in Fatal Accidents by Age

Figure IV.14: Trucks in Fatal Accidents by Age



The Types of Vehicles Involved in Fatal Accidents

Automobiles are clearly more involved than trucks in fatal accidents. Two to three times as many automobiles are involved. Other types of vehicles such as buses and motorcycles are involved even less often than trucks. (See table IV.1.)

Table IV.1: Vehicles Involved in Fatal Accidents

Type of vehicle	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Automobiles													
Small	5,046	5,627	6,506	7,451	8,603	9,795	11,041	10,628	11,572	13,272	14,571	16,806	18,022
Intermediate	2,638	2,810	3,133	3,964	4,945	5,597	6,036	5,359	5,291	5,664	5,488	5,718	5,717
Full-sized	17,942	17,830	18,967	19,983	19,590	18,501	17,193	14,368	13,092	12,752	11,512	11,532	10,403
Size unknown	12,299	10,819	10,321	9,035	6,763	5,065	4,451	4,332	3,686	3,295	2,972	2,532	2,802
Total	**37,925**	**37,086**	**38,927**	**40,433**	**39,901**	**38,958**	**38,721**	**34,687**	**33,641**	**34,983**	**34,543**	**36,588**	**36,944**
Trucks													
Van-based light	1,208	1,186	1,446	1,831	2,037	2,041	1,989	1,775	1,663	1,779	1,853	2,001	2,305
Conventional pickup	6,916	7,710	8,548	9,668	10,331	10,566	10,105	8,970	8,853	9,497	9,850	10,601	11,471
Medium or heavy truck	4,570	4,958	5,724	6,333	6,421	5,589	5,603	4,880	5,159	5,479	5,565	5,468	5,466
Total	**12,694**	**13,854**	**15,718**	**17,832**	**18,789**	**18,196**	**17,697**	**15,625**	**15,675**	**16,755**	**17,268**	**18,070**	**19,242**
Motorcycles	3,265	3,343	4,164	4,643	4,916	5,194	4,963	4,495	4,302	4,659	4,608	4,571	4,062
Buses	327	319	321	372	347	330	342	289	307	320	337	286	354
Other vehicles	1,323	1,333	1,246	725	682	693	816	1,227	1,059	1,144	1,323	1,218	1,147
Total vehicles	**55,534**	**56,084**	**60,516**	**64,144**	**64,762**	**63,485**	**62,699**	**56,455**	**55,106**	**57,972**	**58,271**	**60,792**	**61,825**

Automobiles

While the fact that automobiles have been the most frequent vehicle type involved in fatal accidents is important in itself, breaking down automobiles by size shows even more interesting results. After increasing slightly from 1975 through 1978, the number of full-size automobiles in fatal accidents declined almost 50 percent from 1978 through 1987. The number of intermediate automobiles involved in fatal accidents increased steadily from 1975 through 1981, increasing over 125 percent. Since 1981, the number of intermediate automobiles in accidents has fluctuated; the number in 1987 was slightly below that in the 1981 peak year. The number of small automobiles in fatal accidents has been steadily on the increase. The number of minisize automobiles has increased about 150 percent over 1975, the number of subcompact cars has increased almost 200 percent, and the number of compact cars has increased about 750 percent.

Trucks

Trend patterns for trucks involved in fatal motor vehicle accidents are related to truck type. The number of medium and heavy trucks tends to follow the overall trend, while the number of light trucks and vans is on the increase to such a degree that their numbers tend to dominate the overall total truck trend. The number of light trucks and vans in fatal

accidents has increased almost 70 percent since 1975. The number of medium and heavy trucks in fatal accidents, however, increased about 40 percent from 1975 through 1979 but has since fallen off, so that the number for 1987 is only about 20 percent higher than that in 1975.

Other Vehicles

Other types of vehicles show varying trends of involvement in fatal motor vehicle accidents. The number of motorcycles increased almost 60 percent from 1975 through 1980 but has declined since then, so that the number in 1987 was only about 25 percent more than in 1975. The number of buses has never been very high, never reaching as many as 400 in a year.

Fatalities by Type of Vehicle Involved

Trends in fatal motor vehicle accidents by type of vehicle are generally reflected in the number of fatalities in those vehicles. There are clearly more fatalities in automobiles than in other types of vehicle. There are three to four times as many automobile fatalities as truck fatalities. Fatalities in other types of vehicles such as buses and motorcycles occur even less often. (See table IV.2.)

Table IV.2: Fatalities by Type of Vehicle

Type of vehicle	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Automobiles													
Small	4,289	4,903	5,606	6,351	7,354	8,348	9,220	8,742	9,336	10,662	11,502	13,099	13,902
Intermediate	1,911	2,147	2,265	2,843	3,486	3,999	4,108	3,778	3,743	3,807	3,663	3,902	3,866
Full-sized	10,758	11,074	11,426	12,179	11,797	11,315	9,948	8,154	7,701	7,189	6,339	6,631	5,856
Size unknown	8,992	8,062	7,499	6,793	5,183	3,793	3,375	3,061	2,612	2,322	2,070	1,682	1,850
Total	**25,950**	**26,186**	**26,796**	**28,166**	**27,820**	**27,455**	**26,651**	**23,735**	**23,392**	**23,980**	**23,574**	**25,314**	**25,474**
Trucks													
Van-based light	643	624	745	926	1,019	1,000	958	828	729	775	797	885	1,049
Conventional pickup	4,029	4,706	5,104	5,710	6,102	6,461	6,050	5,110	5,045	5,328	5,477	6,007	6,607
Medium and heavy trucks	1,185	1,303	1,481	1,601	1,569	1,347	1,279	1,041	1,070	1,188	1,120	1,041	957
Total	**5,857**	**6,633**	**7,330**	**8,237**	**8,690**	**8,808**	**8,287**	**6,979**	**6,844**	**7,291**	**7,394**	**7,933**	**8,613**
Motorcycles	3,189	3,312	4,104	4,577	4,894	5,144	4,906	4,453	4,265	4,608	4,564	4,588	4,031
Buses	53	73	42	40	39	46	57	35	51	46	57	18	45
Other vehicles	876	1,335	1,461	1,100	1,153	1,369	1,395	473	314	397	499	400	414
Total fatalities	**35,925**	**37,539**	**39,733**	**42,120**	**42,956**	**42,822**	**41,296**	**35,675**	**34,866**	**36,322**	**36,088**	**38,253**	**38,577**

Automobiles

The number of fatalities in automobiles tends to follow the overall trend in fatal automobile accidents. However, like the number of accidents, there are differences according to size of automobile. The number of fatalities in full-size automobiles has decreased more than 50 percent since the peak year of 1978. Meanwhile, the number of fatalities in intermediate cars more than doubled from 1975 through 1981 and then declined slightly. The number of fatalities in small automobiles has increased steadily since 1975, only 1 year showing any decrease. This trend toward increase is apparent regardless of the type of small automobile.

Trucks

The number of fatalities in trucks has been rather steadily increasing over the years but the increase is dominated by fatalities in van-based light trucks and conventional pickup trucks. Fatalities in trucks approached their highest level in 1987, reflecting an increase of about 47 percent since 1975. Fatalities in light trucks account for a substantial proportion of these fatalities and, in turn, fatalities in conventional pickups account for most of the light truck fatalities. The number of all light truck fatalities in 1987 was almost 65 percent higher than in 1975; the number of fatalities in van-based trucks was also almost 65 percent higher than in 1975, as were the number in conventional pickups. However, the number of fatalities in medium and heavy trucks increased from 1975 through 1978, but they have since declined about 40 percent to a low in 1987 that was almost 20 percent less than in 1975.

Other Vehicles

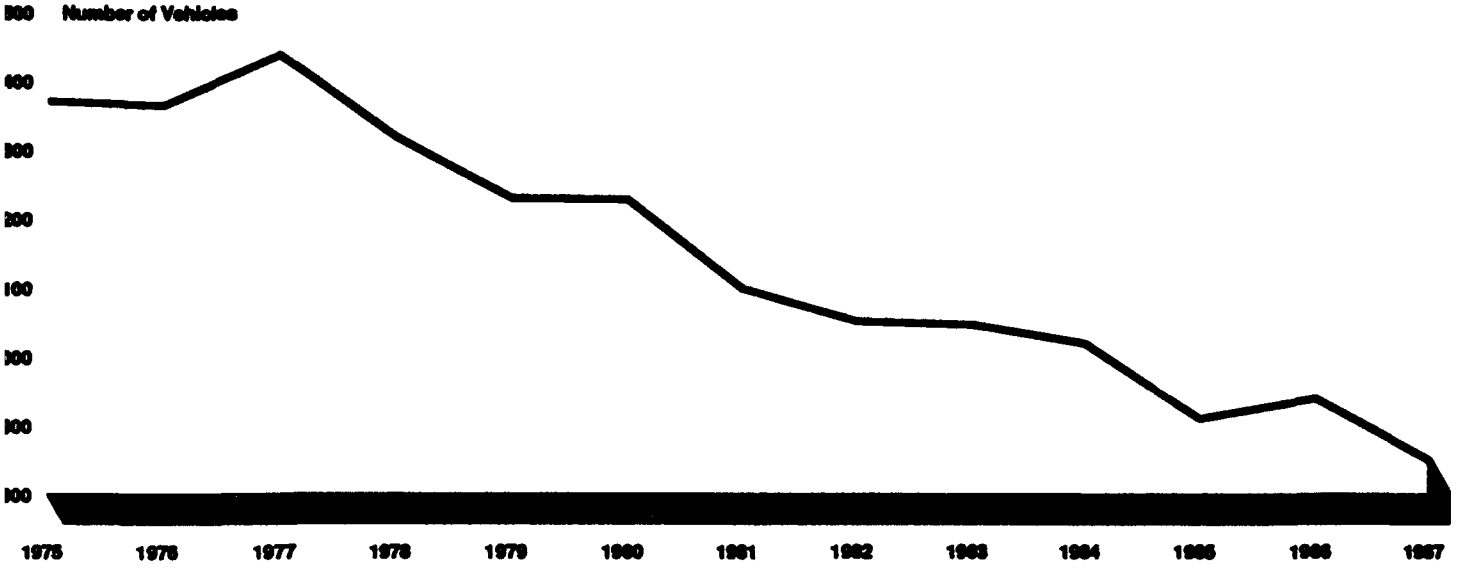
Motorcycle fatalities follow a trend similar to that for medium and heavy trucks. After increasing more than 60 percent from 1975 through 1980, motorcycle fatalities declined more than 20 percent through 1987. The number of fatalities on buses has never been large, generally accounting for only 30 to 40 fatalities per year.

Vehicle Tires and Fatal Accidents

One of the Subcommittee's requests was that we inquire into the use of studded tires and their effects, if any, on fatal accidents. The FARS system, unfortunately, does not routinely collect information on the effects of tires on fatal accidents; there are no specified elements on the FARS data collection instruments to collect data on tires. Some data on tires is collected but only when accident investigators use a miscellaneous category called "related factors." We analyzed the "related factors" variables and found that, over the years, tires are being reported less and less as a contributing factor in fatal motor vehicle accidents. (See figure

IV.15.) Even in the peak year of 1977, only about 1,400 vehicles in fatal accidents were reported as having problems with tires. This number declined more than 40 percent until, in 1987, only 850 vehicles were reported with tires as a contributing factor. In none of these instances was the use of studded tires specifically reported.

Figure IV.15: Tires as a Contributing Factor in Fatal Accidents



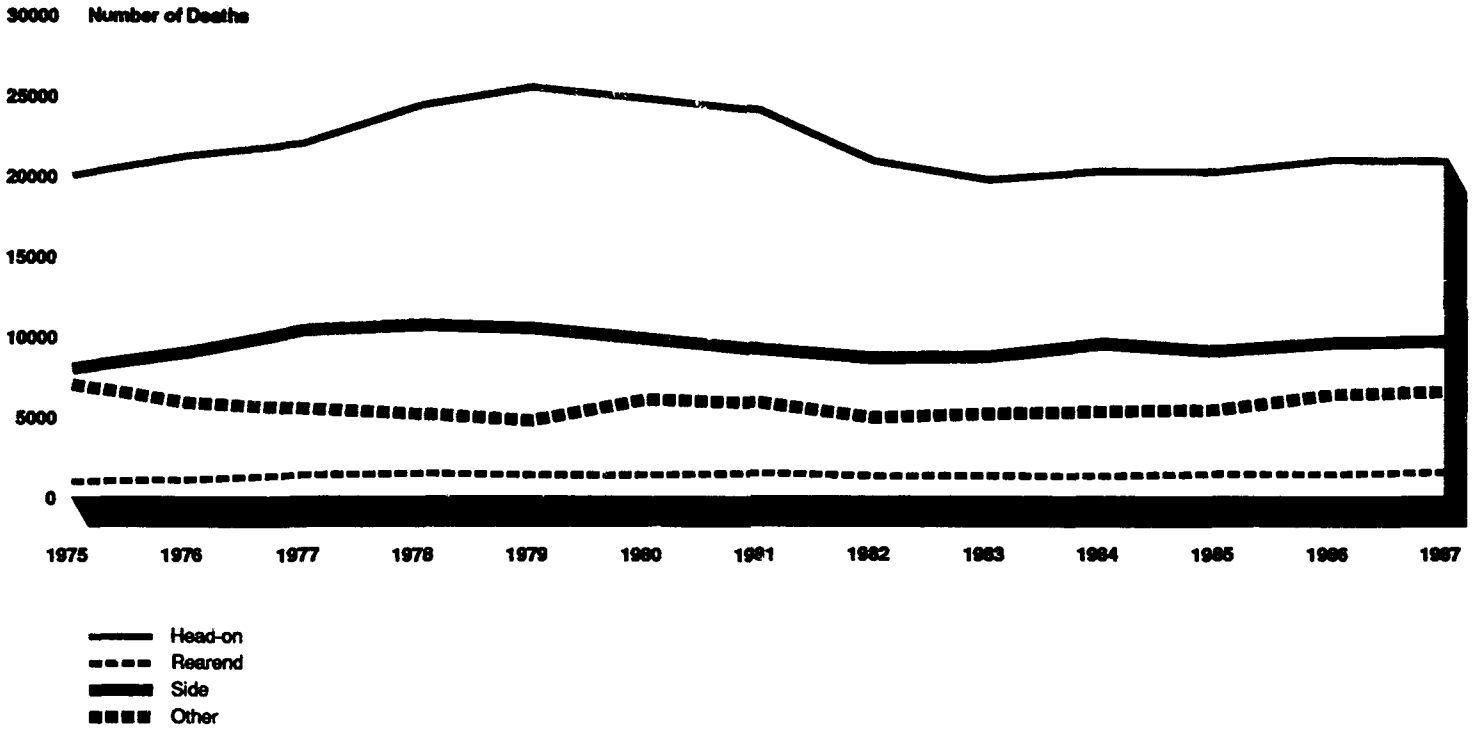
Vehicle Fatalities and Collisions

Most fatalities in vehicles occur from head-on impacts, whether the head-on collision is the initial or principal impact.[3] (See figures IV.16 and IV.17.) Fatalities from collision with the side, whether passengers' or drivers' side, taken together were consistently less than 50 percent of the fatalities from head-on impacts. Fatalities in head-on impacts tend to follow the overall trend, as do fatalities from drivers' and passengers' side impacts. Fatalities from rearend impacts, however, are on the increase. (See figure IV.18 on page 84.) The trend when the impact was classified as top, undercarriage, override, or underride is not clear. When only the initial impact is considered, fatalities follow the overall

[3]Initial impact is the first vehicle impact that produces property damage or personal injury. Principal impact is the vehicle impact, initial or otherwise, that produces the most property damage or serious injury.

trend. When only principal impact is considered, however, such fatalities have been generally on the decline since 1979. Fatalities from noncollision accidents, after an initial decline from 1975 through 1978, have been steadily increasing since then, an increase of more than 70 percent. (See figure IV.19 on page 84.)[1]

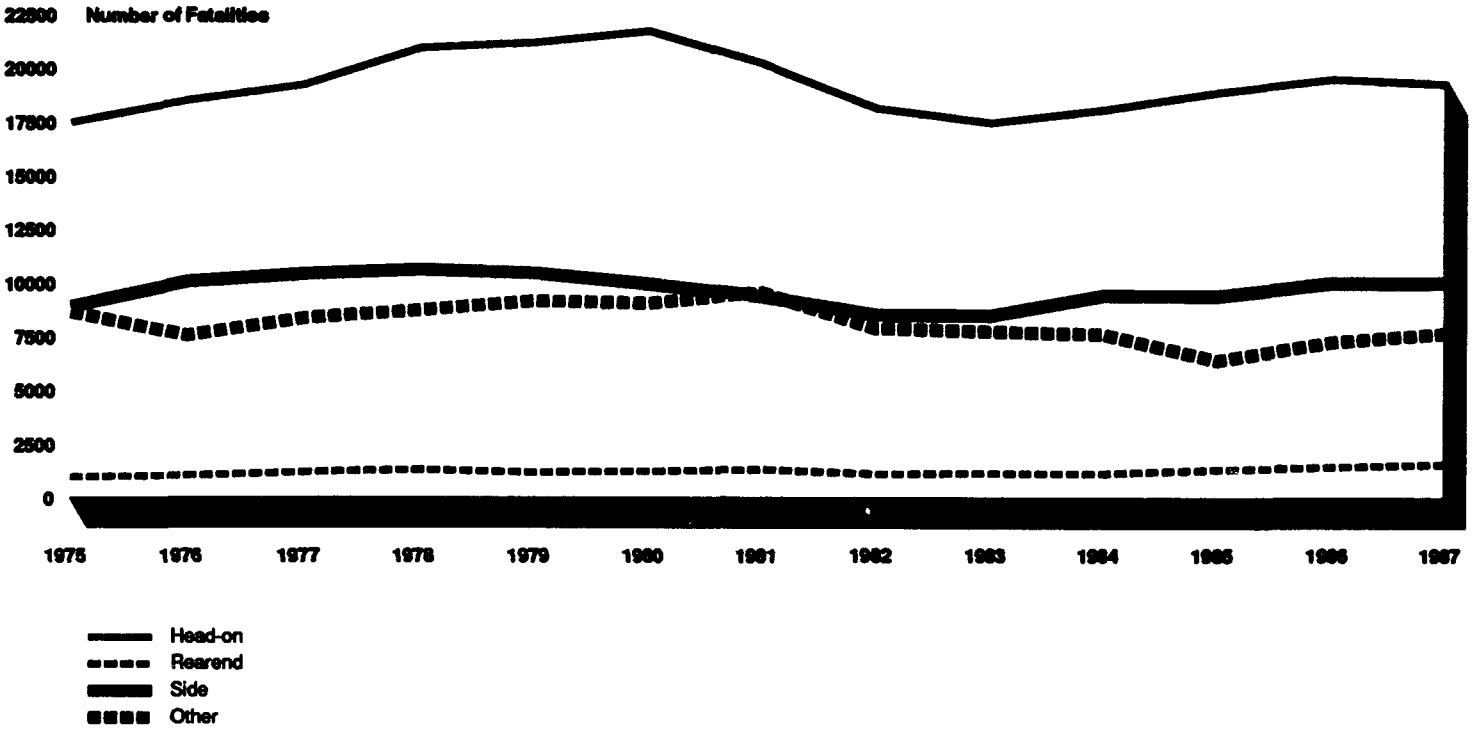
Figure IV.16: Vehicle Fatalities by Direction of Initial Impact[a]



[a]"Other" includes accidents in which the initial impact was described as noncollision, top, undercarriage, underride, override, or unknown.

[1]Noncollision accidents are accidents in which the either no impact occurs or the most harmful accident event is (1) an overturn, (2) fire or explosion, (3) immersion, (4) gas inhalation, (5) a fall from the vehicle, (6) an injury in the vehicle, or (7) damage from a thrown or falling object.

Figure IV.17: Vehicle Fatalities by Direction of Principal Impact[a]



[a]"Other" includes accidents in which the principal impact is described as noncollision, top, undercarriage, override, or unknown.

Figure IV.18: Vehicle Fatalities With Principal Rearend Impact

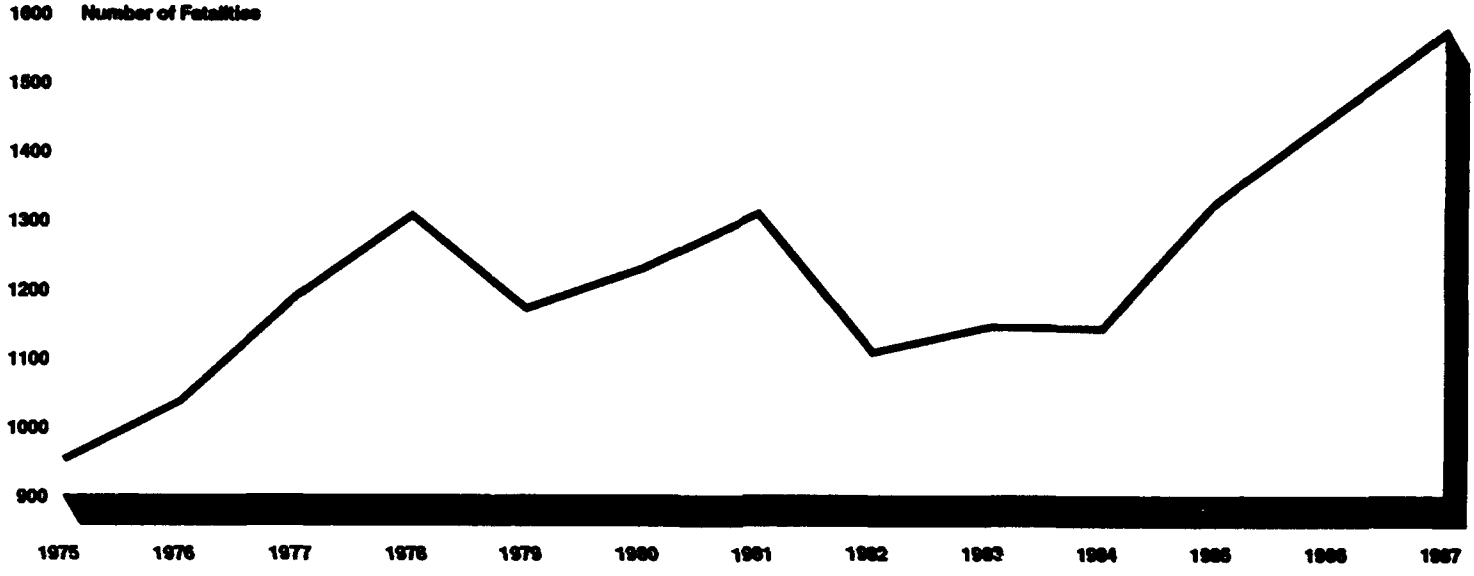
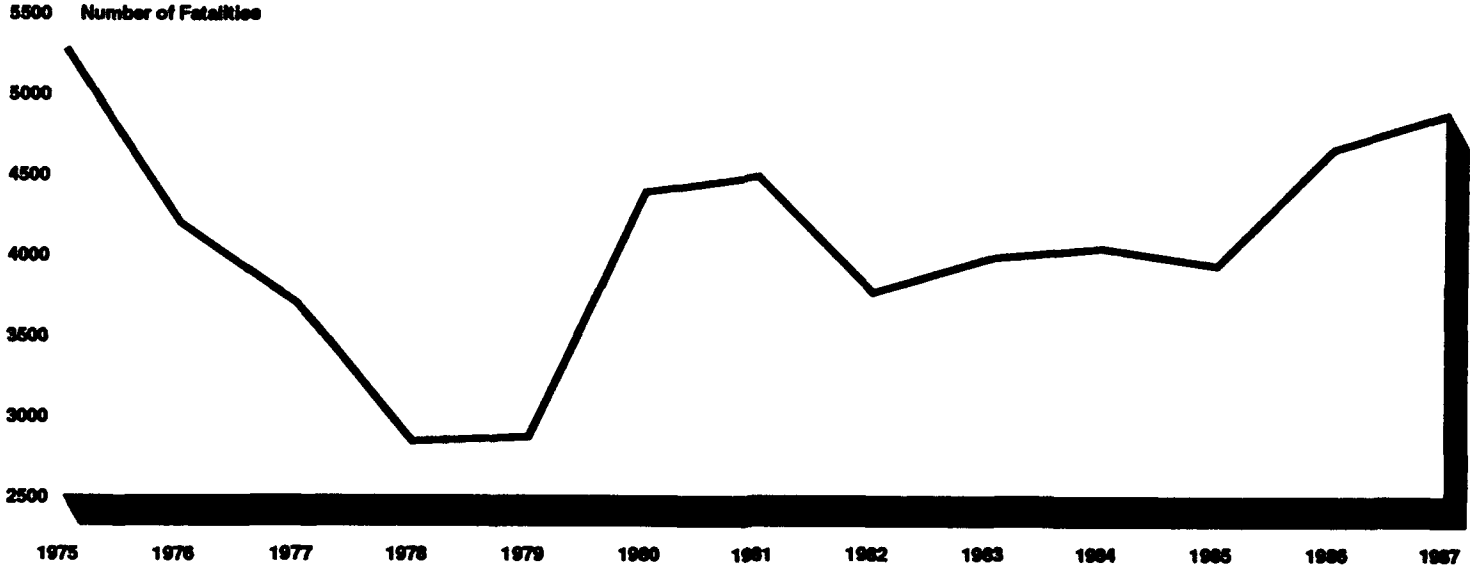


Figure IV.19: Vehicle Fatalities From Noncollision Accidents



Conclusions

The types of vehicles involved in fatal accidents has been changing over the years. More and more small cars are involved in fatal motor vehicle

accidents, and so are more and more light trucks and vans. Fatalities in these vehicles are also on the increase. However, the fatal accident involvement rates and the fatality rates per number of registered vehicles are still generally declining. Exceptions to the general decline in these rates are the rates for subcompact automobiles and conventional pickup trucks, which have been increasing since 1983. Even though accident involvement rates and fatality rates for small automobiles have been declining, they are still a matter of concern, since they are considerably higher than those of larger automobiles. While medium and heavy trucks have one of the lowest occupant fatality rates, they have one of the highest fatal accident involvement rates. Age of vehicle does not appear to be as important a factor for automobiles as for trucks, since automobiles of all ages have very similar accident involvement rates. The only types of accidents that showed trends different from the overall trend are rearend collisions and noncollision accidents, which have been increasing rather steadily.

Statistics Related to the Driving Environment

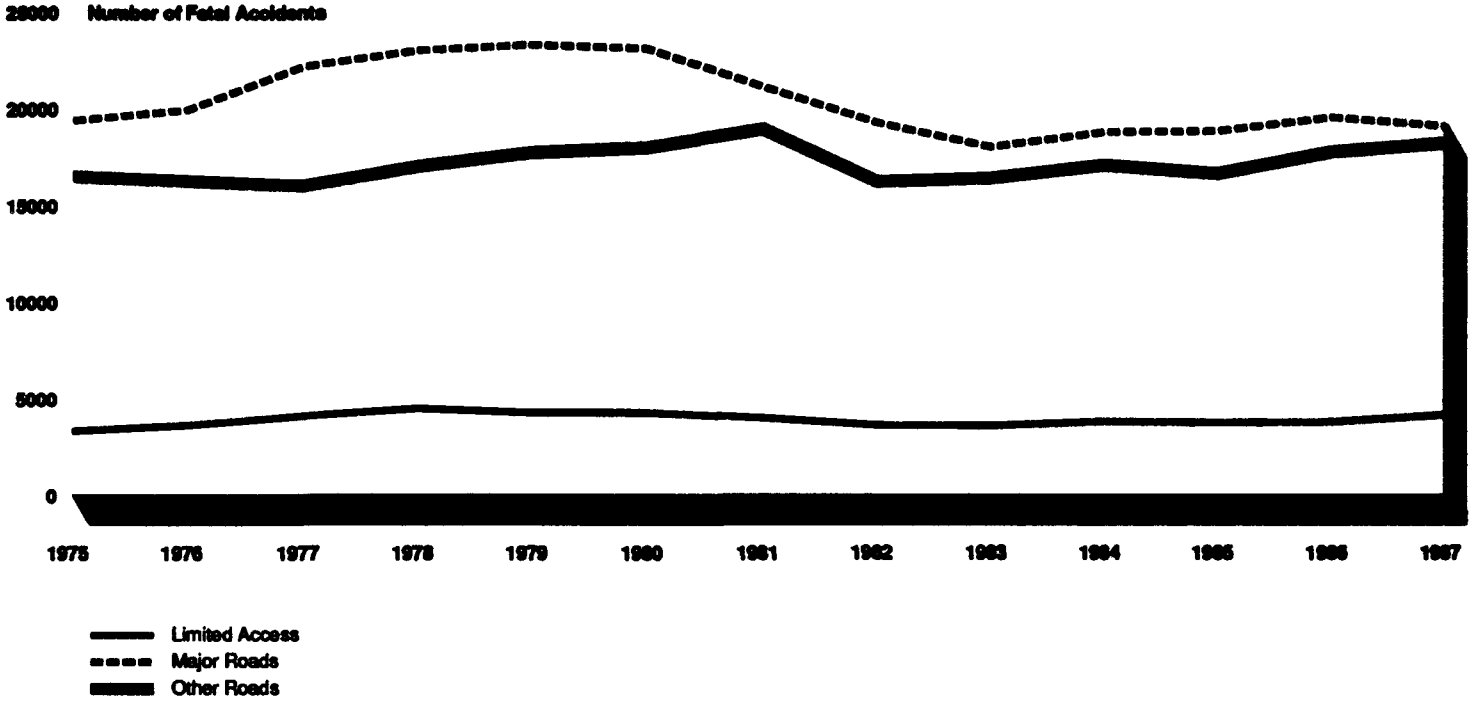
Elements of the driving environment—such as weather, time of day, and type of roadway—can also contribute to fatal motor vehicle accidents. In this appendix, we discuss various aspects of the driving environment and their relationship to fatality trends. Since most legislation addressing environmental issues has addressed roadway conditions and roadway hazards, we address the roadways first. Finally, we discuss elements that legislation cannot address directly—such as weather and time of day—but that, like speed limits, can be addressed through local law enforcement. Since exposure information specifically related to environmental conditions was not readily available and since many of the phenomena discussed occur infrequently, we discuss only the basic accident frequencies.

Fatal Accidents by Type of Roadway

Most fatal motor vehicle accidents occur on major roads such as U.S.-numbered and state-numbered routes and similar major arteries. (See figure V.1.) Local, county, and other roads are the locations for the next highest number. The fewest accidents occur on limited-access highways or freeways. In nearly all the years covered by our analysis, over five times as many fatal accidents occurred on major roads as on limited-access highways, and over four times as many occurred on local roads. These ratios have remained fairly constant over the years, although the ratio of major highway to limited-access highway accidents is declining somewhat. This suggests that speed-limit legislation addressing only limited-access highways is not necessarily the optimal method of cutting the number of fatal accidents.

Fatal accidents on limited-access highways are becoming more of a problem in recent years, however. Although fatal accidents on both limited-access highways and major roads tend to follow the overall trend, accidents on limited-access highways have been increasing at a faster rate since 1983. The number of fatal accidents on limited-access highways has increased slightly over 15 percent since 1983, while the number on major roads has increased only a little over 5 percent. However, recent NHTSA reports indicate that a large part of the fatality increase stems from increased travel on limited-access highways and that the fatality rate per miles traveled shows a much smaller rate of increase. Fatal accidents on local roads have increased over 10 percent since 1983, the 1987 total of 18,200 accidents being only about 700 less than for the 1981 peak year for such accidents.

Figure V.1: Fatal Accidents by Type of Roadway



Roadway Conditions

Roadway surface conditions are not a major factor in most fatal accidents, since over 80 percent of all fatal accidents occur on dry roads. (See table V.1.) Accidents on both wet and dry roads tend to follow the overall trend. Fatal accidents under other road surface conditions such as snow and ice have always been few in number.

Table V.1: Fatal Accidents by Road Surface Condition

Condition	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Dry	31,630	32,848	34,170	36,312	36,201	38,062	36,666	31,515	30,618	32,233	31,818	33,909	34,417
Wet	5,752	5,133	5,942	5,958	6,929	5,272	5,496	5,823	5,734	5,673	5,439	5,801	5,625
Snow or slush	657	549	748	778	833	843	779	775	694	685	902	497	566
Ice	722	833	956	963	846	727	506	667	620	788	802	604	587
Other	400	384	395	422	414	380	553	312	310	252	235	279	240
Total accidents	**39,161**	**39,747**	**42,211**	**44,433**	**45,223**	**45,284**	**44,000**	**39,092**	**37,976**	**39,631**	**39,196**	**41,090**	**41,435**

Roadside and Traffic Conditions

The Subcommittee expressed particular interest in how such elements as roadside hazards, narrow bridges, traffic controls, and the like affect fatal accidents. Unfortunately, FARS does not routinely collect data on many of these elements, and no specific provision is made for them on the FARS data collection instrument. For some elements, information is available only when accident investigators specifically report them as "contributing factors." Therefore, we can report some information, but we do not have a good sense of the completeness of the data.

Accidents and Traffic Controls

Most fatal accidents—about 80 percent—occur where there are no traffic controls. (See table V.2.) Whether controls are present or not, fatal accidents tend to follow the overall trend. However, when individual types of traffic controls are considered, trend differences do appear. Accidents occurring where there are stop signals—either lights or stop signs—follow the overall trend. However, accidents where railroad signals exist are on the decline while accidents where only yield signals exist are just as clearly increasing. Accidents where other unidentified types of traffic controls existed increased steadily from 1975 through 1980 and then decreased rapidly through 1982 to the earlier level, and they have been rather constant since. Accidents where existing traffic controls were not functioning have always been few.

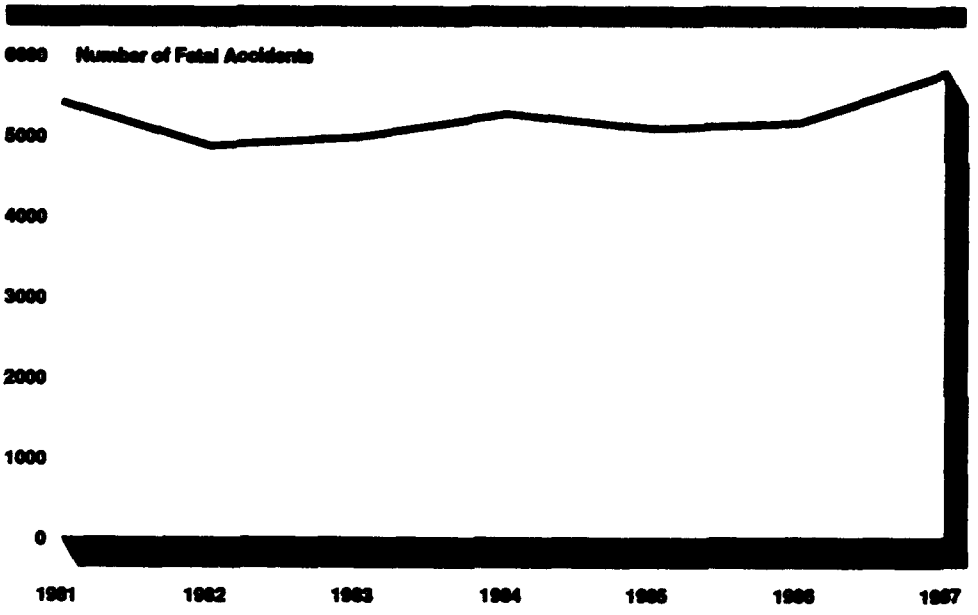
Table V.2: Fatal Accidents by Type of Traffic Control

Control	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
None	31,638	31,920	33,774	35,399	35,752	34,841	34,353	31,514	30,916	31,862	31,462	33,094	33,203
Stop signal													
Color signal	1,913	1,937	2,097	2,216	2,389	2,382	2,346	1,894	1,925	2,048	2,069	2,202	2,209
Stop sign	2,952	3,073	3,287	3,633	3,542	3,339	3,386	2,979	2,627	2,930	3,023	3,179	3,349
Total	**4,865**	**5,010**	**5,384**	**5,849**	**5,931**	**5,721**	**5,732**	**4,873**	**4,552**	**4,978**	**5,092**	**5,381**	**5,558**
Yield signal													
Flashing signal	278	243	255	273	289	260	292	280	259	281	251	269	299
Yield sign	167	155	174	162	184	187	144	161	114	133	140	158	121
School zone sign	11	12	15	5	8	7	6	6	6	15	9	9	9
Pedestrian signal	0	0	0	32	43	53	52	240	169	217	195	174	225
Total	**456**	**410**	**444**	**472**	**524**	**507**	**494**	**687**	**548**	**646**	**595**	**610**	**654**
Railroad crossing													
Physical control	185	188	200	230	203	223	237	78	70	86	79	89	74
Stop sign	156	155	148	145	129	109	96	51	46	60	29	27	29
Other	275	331	302	308	302	275	192	301	282	366	305	316	314
Total	**616**	**674**	**650**	**683**	**634**	**607**	**525**	**430**	**398**	**512**	**413**	**432**	**417**
Traffic control not functioning	50	37	42	32	40	53	40	94	76	65	68	76	32
Other	1,279	1,452	1,696	1,819	2,214	3,396	2,500	1,390	1,419	1,519	1,482	1,456	1,523
Unknown	257	244	221	179	128	159	356	104	67	49	84	41	48
Total accidents	**39,161**	**39,747**	**42,211**	**44,433**	**45,223**	**45,284**	**44,000**	**39,092**	**37,976**	**39,631**	**39,196**	**41,090**	**41,435**

Freeway Signs

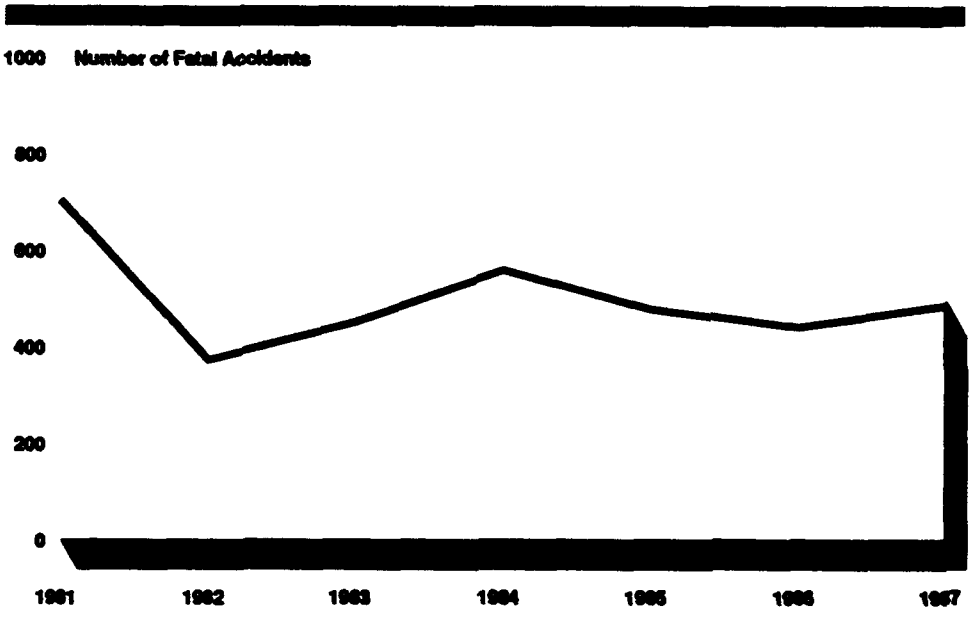
FARS has recorded data specifically on freeway accidents only since 1981. Since then, freeway accidents have accounted for less than 15 percent of all fatal accidents. However, after a slight drop in 1982, the total number of fatal accidents on freeways has increased about 18 percent. (See figure V.2.) The bulk of this increase occurred in 1987. In most years, over 90 percent of these accidents occurred where no special signs or other traffic controls existed. The pattern of accident increase on freeways tends to be more intense when no freeway traffic controls exist. (See figure V.3.)

Figure V.2: Fatal Accidents on Freeways[a]



[a]Data specifically related to freeways not available prior to 1981.

Figure V.3: Freeway Fatal Accidents With Some Traffic Controls[a]

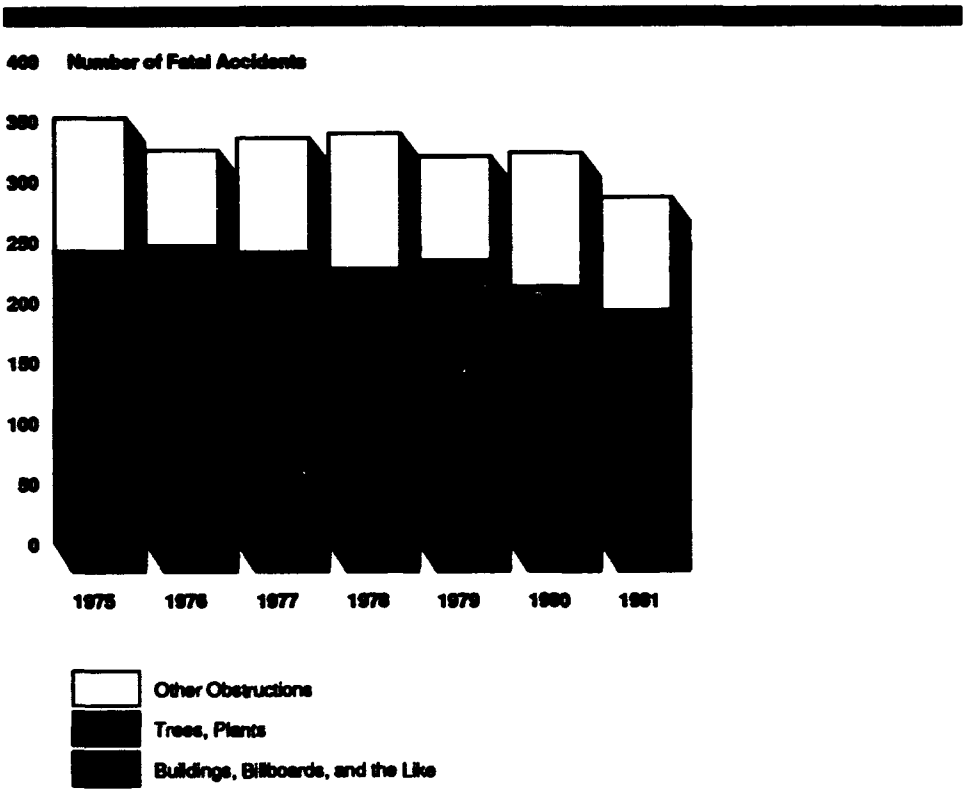


[a]Data specifically related to freeways not available prior to 1981.

Roadside Hazards

FARS reports roadside hazards as a problem for very few fatal accidents; they never total more than 400 accidents a year, and the total of such hazards has been decreasing rather steadily. (See figure V.4.) As a consequence, the FARS system stopped collecting special data on hazards after 1981. Over half the hazards reported were trees or plants; buildings and billboards accounted for fewer than 60 fatal accidents per year. Other roadside hazards were present at fewer than 120 fatal accidents per year. Because of the small numbers involved and the short time, not much can be said about individual types of hazards.

Figure V.4: Fatal Accidents Involving Roadside Hazards[a]



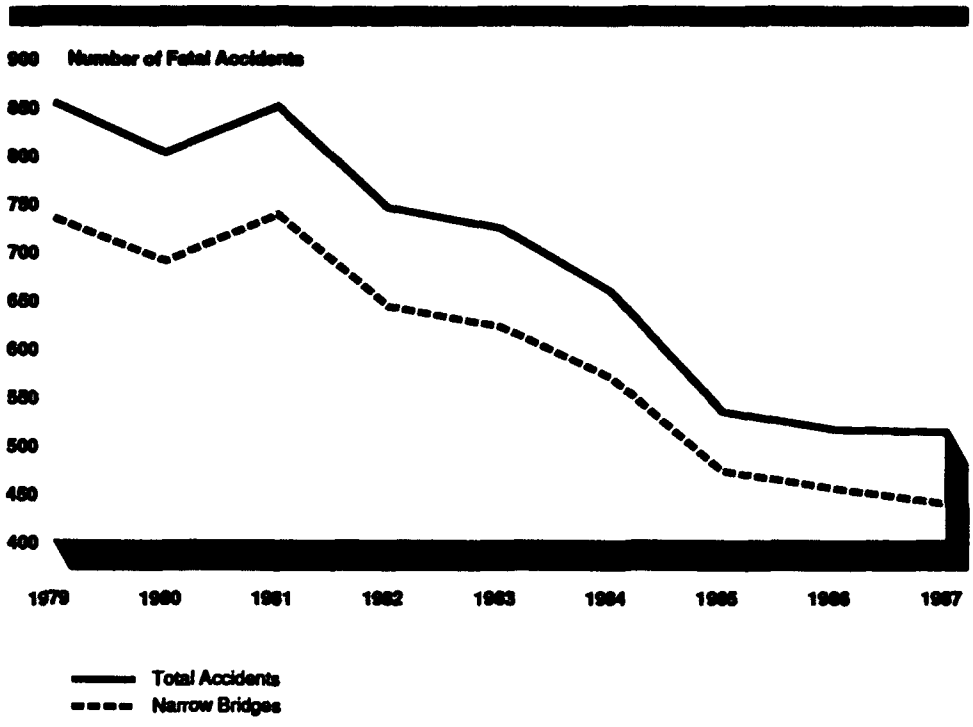
[a]Data not routinely collected after 1981.

Narrow-Bridge Accidents

The Subcommittee expressed interest in bridge accidents, especially narrow-bridge accidents. Bridge accidents in total have always been fewer than 1,000 per year, and accidents involving narrow bridges have been

even fewer. (See figure V.5.)[1] Moreover, these accidents have been steadily on the decline. The number of vehicles actually striking bridges is even smaller than the number of accidents involving bridges, and this number has been steadily declining. (See figure V.6.) Only 450 such accidents occurred in 1987.

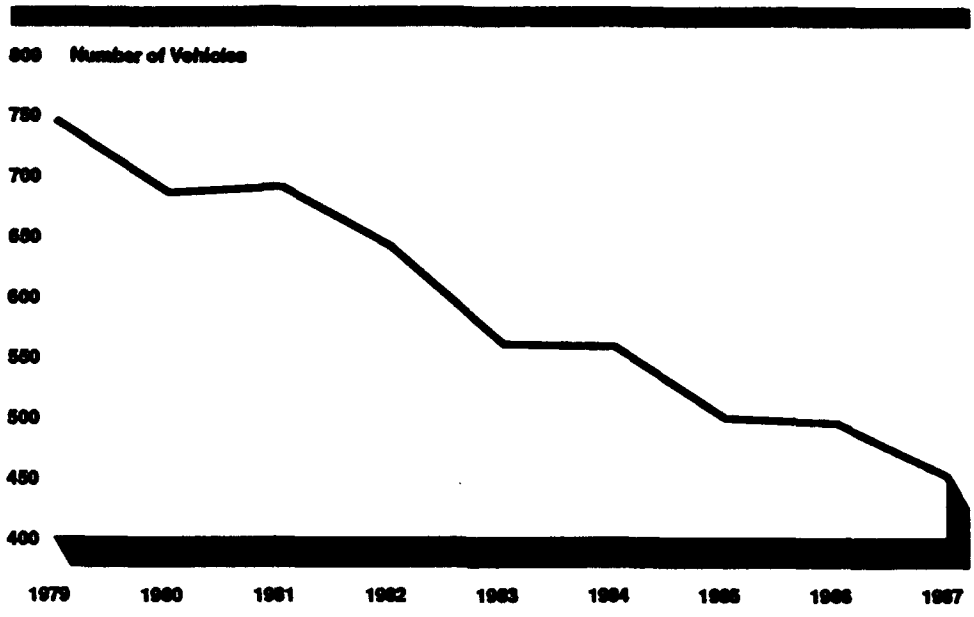
Figure V.5: Fatal Accidents Involving Bridges[a]



[a]Data not routinely collected prior to 1979.

[1]One-lane bridges accounted for very few fatal accidents. Therefore, this analysis is based on accidents involving one- and two-lane bridges.

Figure V.6: Vehicles Involved in Bridge Accidents[a]



[a]Data not routinely collected prior to 1979.

Fatal Accidents and Weather Conditions

Weather is not a significant factor in most fatal accidents, over 80 percent of the accidents occurring under what was classified as normal weather conditions. (See table V.3.) The number of normal weather accidents tends to follow the overall trend, while accidents in adverse weather show inconsistent trends.

Table V.3: Fatal Accidents by Type of Weather Condition

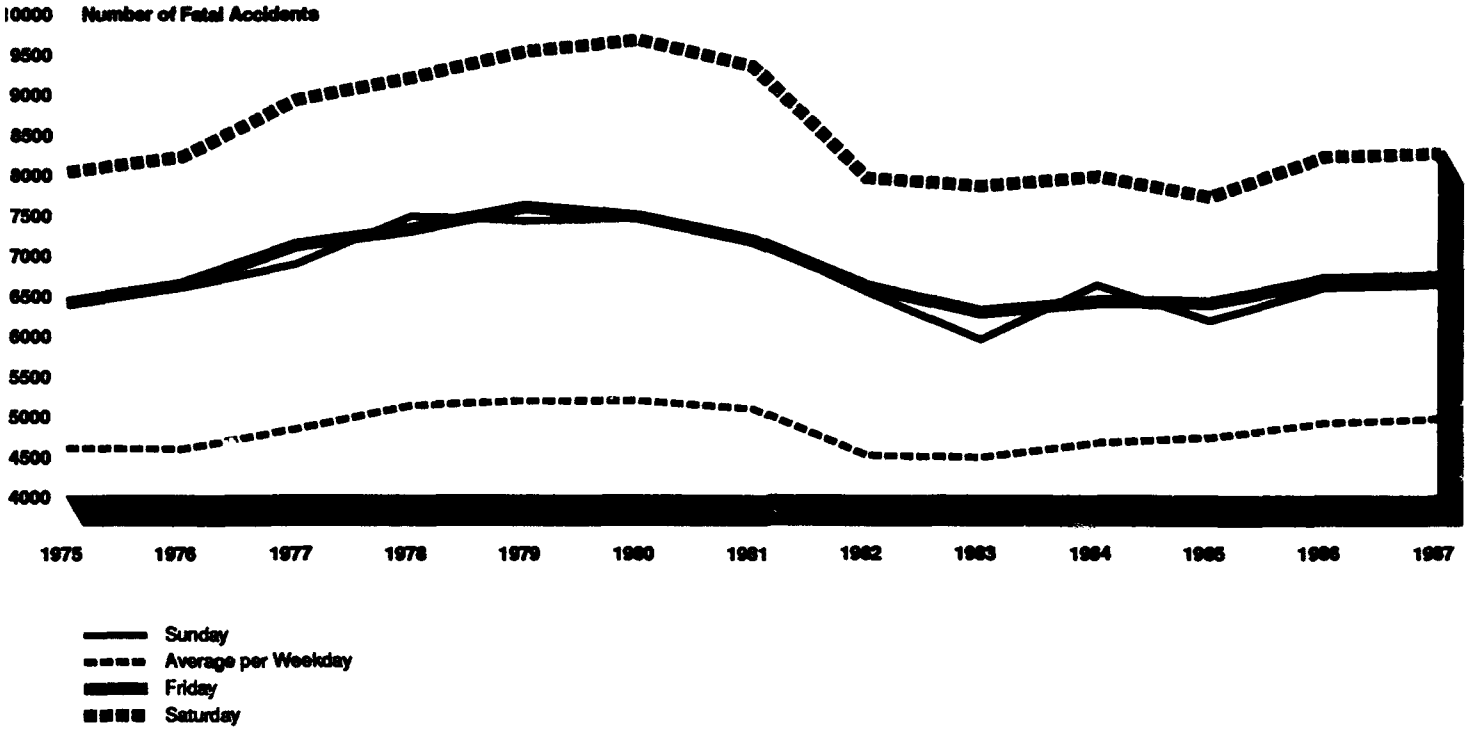
Condition	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Normal	32,847	34,126	36,545	38,526	38,677	39,759	38,377	33,374	32,381	34,197	33,647	35,748	36,159
Rain	3,953	3,514	3,841	3,965	4,565	3,597	3,723	3,939	4,088	3,645	3,733	3,851	3,777
Sleet	80	70	77	137	109	107	86	108	107	110	114	91	119
Snow	742	649	755	644	672	808	632	603	681	636	805	475	622
Fog or other	728	543	623	799	864	797	809	876	562	910	770	784	645
Unknown	811	845	370	362	336	216	373	192	157	133	127	141	113
Total accidents	**39,161**	**39,747**	**42,211**	**44,433**	**45,223**	**45,284**	**44,000**	**39,092**	**37,976**	**39,631**	**39,196**	**41,090**	**41,345**

Fatal Accidents by Day of the Week

Most fatal accidents occur on weekends, a pattern that is consistent throughout the years. (See figure V.7.) About 20 percent of all fatal accidents occur on Saturdays, Saturday accidents accounting for almost 2,000 more accidents each year than for Fridays and Sundays, the next

highest days. The pattern for all days, however, tends to follow the overall trend. The occurrence of most fatal accidents on weekends appears not to be related to the existence of more motor vehicle activity on weekends. Data from the 1983 Nationwide Personal Transportation Survey indicate that not only are more total miles driven on weekdays than on weekends but also the average per weekend day is less than the average per weekday.[2] These same relationships exist for the number of vehicle trips on weekends and weekdays. It would seem, therefore, that some aspects of driving behavior—perhaps drinking and driving—are more responsible for fatal accidents than the volume of travel. (See table V.4.)

Figure V.7: Fatal Accidents by Day of the Week



[2]For calculating averages, we counted 5 weekday days (Monday-Friday), four weekday nights (Monday-Thursday), two weekend days (Saturday and Sunday), and three weekend nights (Friday-Sunday).

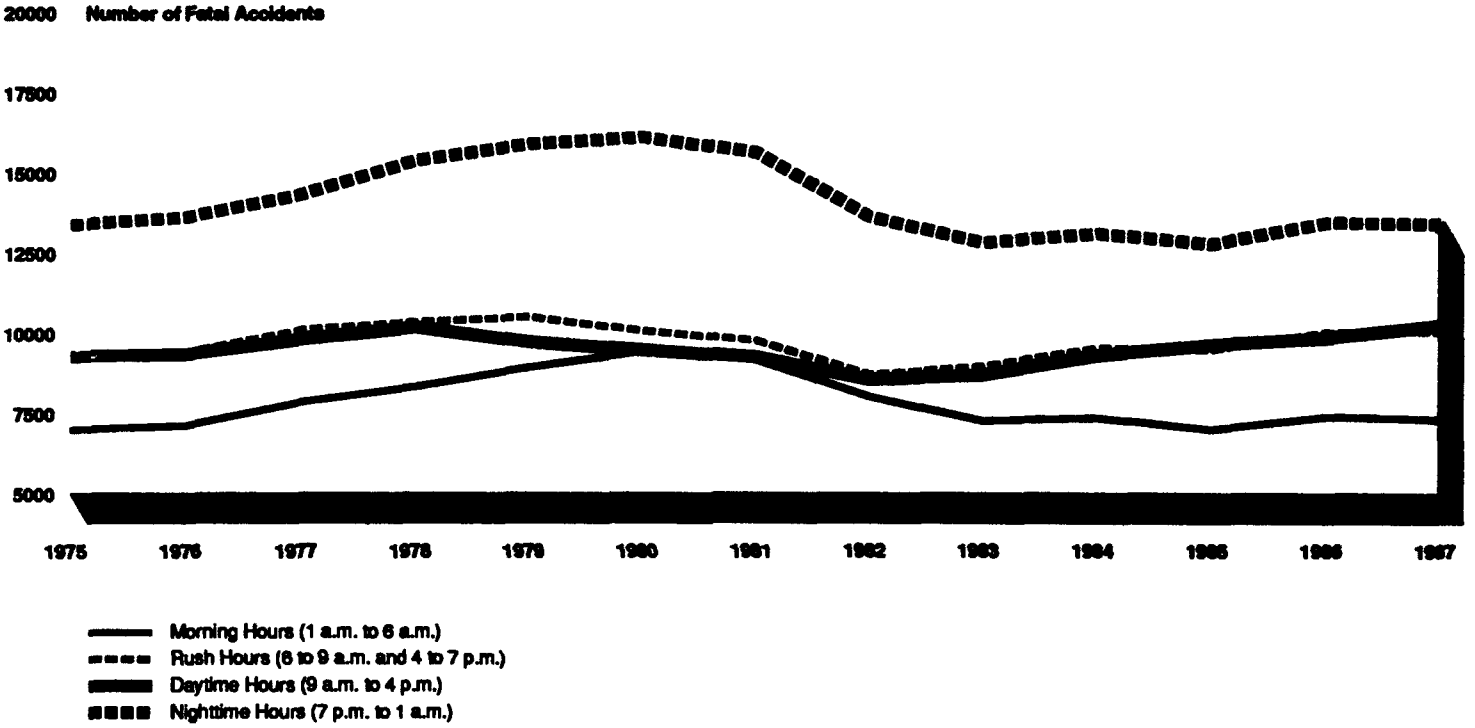
ıble V.4: Vehicle Trips and Miles in 983 by Day of the Week

Time	Percent of trips	Percent of miles	Percent of trips per day	Percent of vehicle miles traveled per day
Weekday day	57.7%	54.4%	11.5%	10.9%
Weekday night	17.7	17.5	4.4	4.4
Weekend day	17.3	19.7	8.7	9.9
Weekend night	6.8	7.8	2.3	2.6
Unknown	0.5	0.6		

ıccidents by the Time ıf Day

Most fatal traffic accidents occur during the nighttime hours of 7:00 p.m. through 1 a.m. (See figure V.8.) Fatal accidents in this time period tend to follow the overall trend, but the total in 1987 was more than 15 percent below the peak year of 1980. Accidents in daytime and rush hours show some tendency to follow the overall trend, but they increased after 1982, and 1987 was the peak year for accidents in both time periods. Early morning accidents declined more than 20 percent from 1980 to 1983 and have remained rather steady since. Comparing data from the 1983 Nationwide Personal Transportation Study to fatal accidents for that year shows that the percentage of fatal accidents in the early morning hours is about four times the percentage of vehicle miles traveled for that time period. (See table V.5.) The percentage of fatal accidents during nighttime hours is over twice the percentage of vehicle miles traveled for that time period. However, the percentage of fatal accidents in rush hour or other daytime periods is far less than the percentage of vehicle miles traveled for those periods. As for the day of accidents, it would seem that aspects of driver behavior are more responsible for fatal accidents than volume of travel is.

Figure V.8: Fatal Accidents by the Time of Day[a]



[a]Times are based on those reported in the 1983 Nationwide Personal Transportation Survey.

Table V.5: Relationship of 1983 Accidents to Vehicle Miles Traveled by Time of Day

Time	Percent of accidents	Percent of vehicle miles traveled
Morning	19.1%	4.8%
Rush hours	23.7	39.1
Daytime	22.9	40.7
Nighttime	33.7	14.8
Unknown	0.6	0.6

Accidents by Season of the Year

More fatal accidents occur during the summer than during the other seasons of the year.[3] However, the numbers for spring and fall are not far behind. (See figure V.9.) The number of fatal accidents in the various

[3]The FARS data system collects data by month. For this analysis, winter is January, February, and December of each year. Spring is March through May, summer is June through August, and fall is September through November.

seasons is strongly correlated to the vehicle miles traveled for those seasons. (See table V.6.) While the fatal accident number for each season tends to follow the overall trend, each showed a different peak year, ranging from 1978 through 1981. Season appears to affect when accidents occur within a year, while changes across years appear more to reflect the overall trend.

Figure V.9: Fatal Accidents by Season of the Year

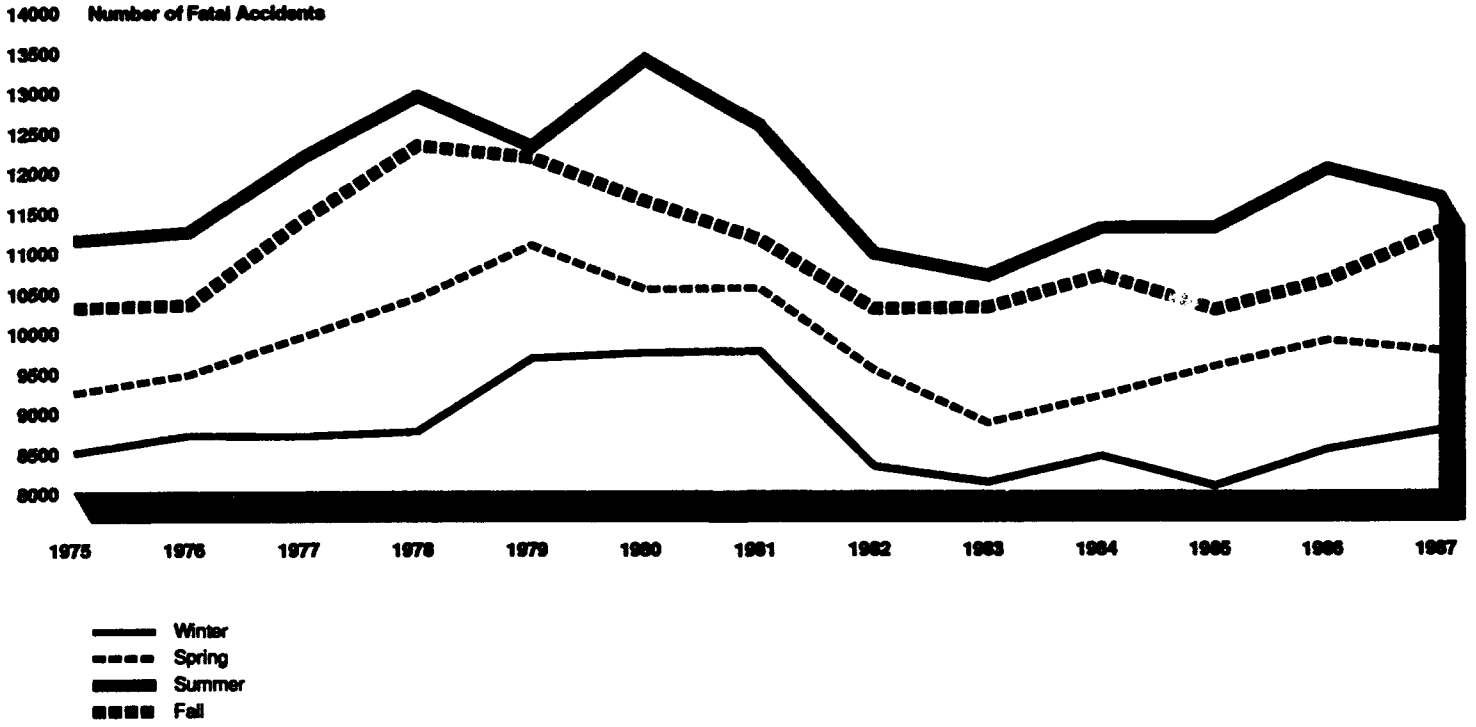


Table V.6: Relationship of 1983 Accidents to Vehicle Miles Traveled by Season

Season	Percent of accidents	Percent of vehicle miles traveled
Summer	28.2%	24.1%
Spring	23.3	28.1
Winter	21.4	22.8
Fall	27.1	25.0

Conclusions

While the numbers of fatal accidents under various environmental conditions reflect the effects of those conditions within any particular year, they tend not to cause trend patterns to deviate from the overall trend. Exceptions include some of the specific areas of the Subcommittee's concern—namely, traffic controls, freeway accidents and freeway signs, roadside hazards, and narrow bridges. The number of accidents related to roadside hazards and narrow bridges appears to be steadily declining. Accidents where only "yield" traffic controls exist are on the increase. Freeway accidents are increasing the most where no traffic controls are present. However, accidents have increased the most on county and other local roads.

Appendix VI

Major Contributors to This Report

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